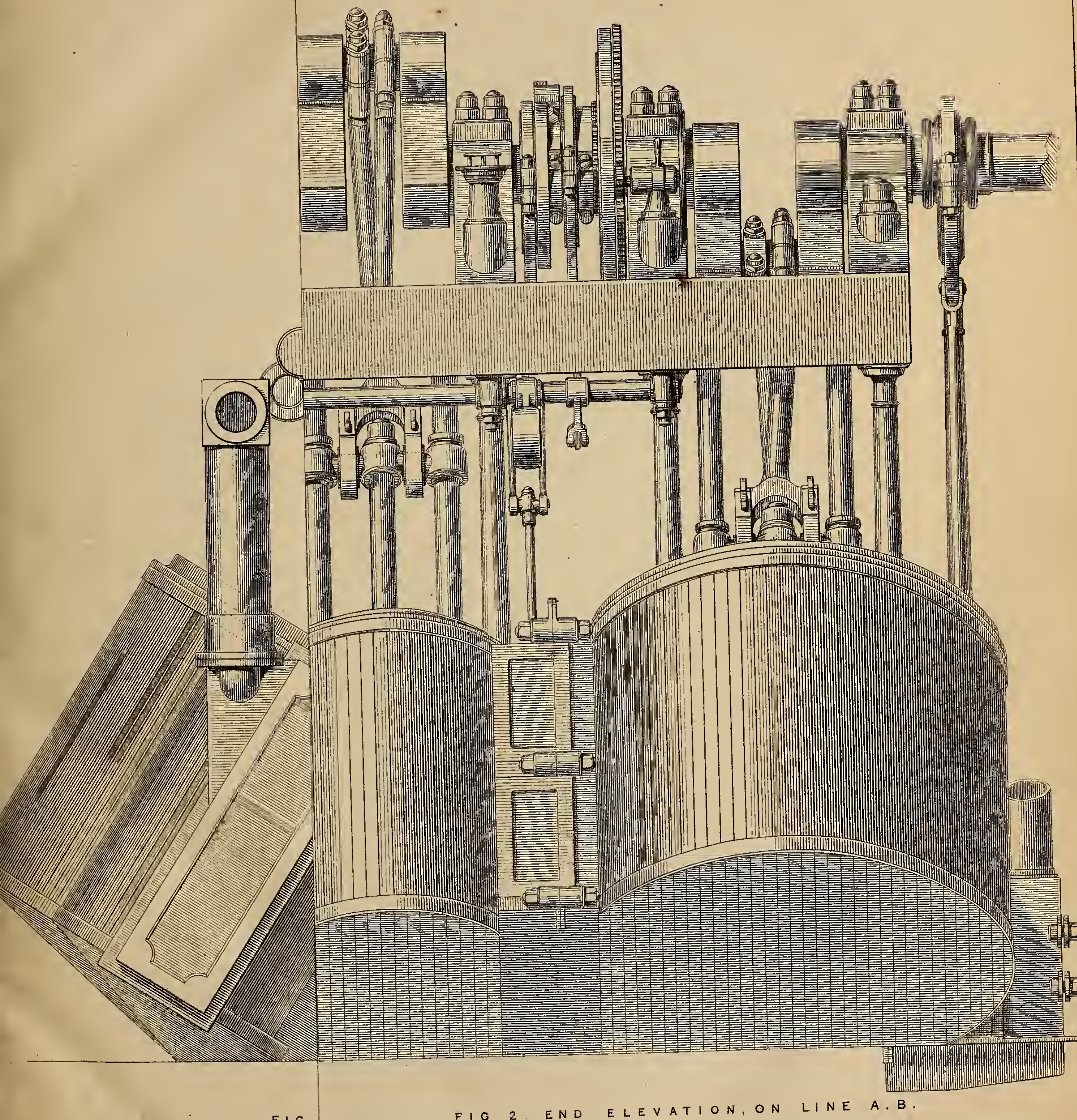
SHIP



FIG

FIG 2. END ELEVATION, ON LINE A.B.

18 20 Feet

ENGINES OF THE PACIFIC STEAM NAVIGATION COMPYS STEAM SHIP "VALPARAISO"

CONSTRUCTED BY MESSRS RANDOLPH, ELDER & Co ENGINEERS, GLASGOW. PATENTEES

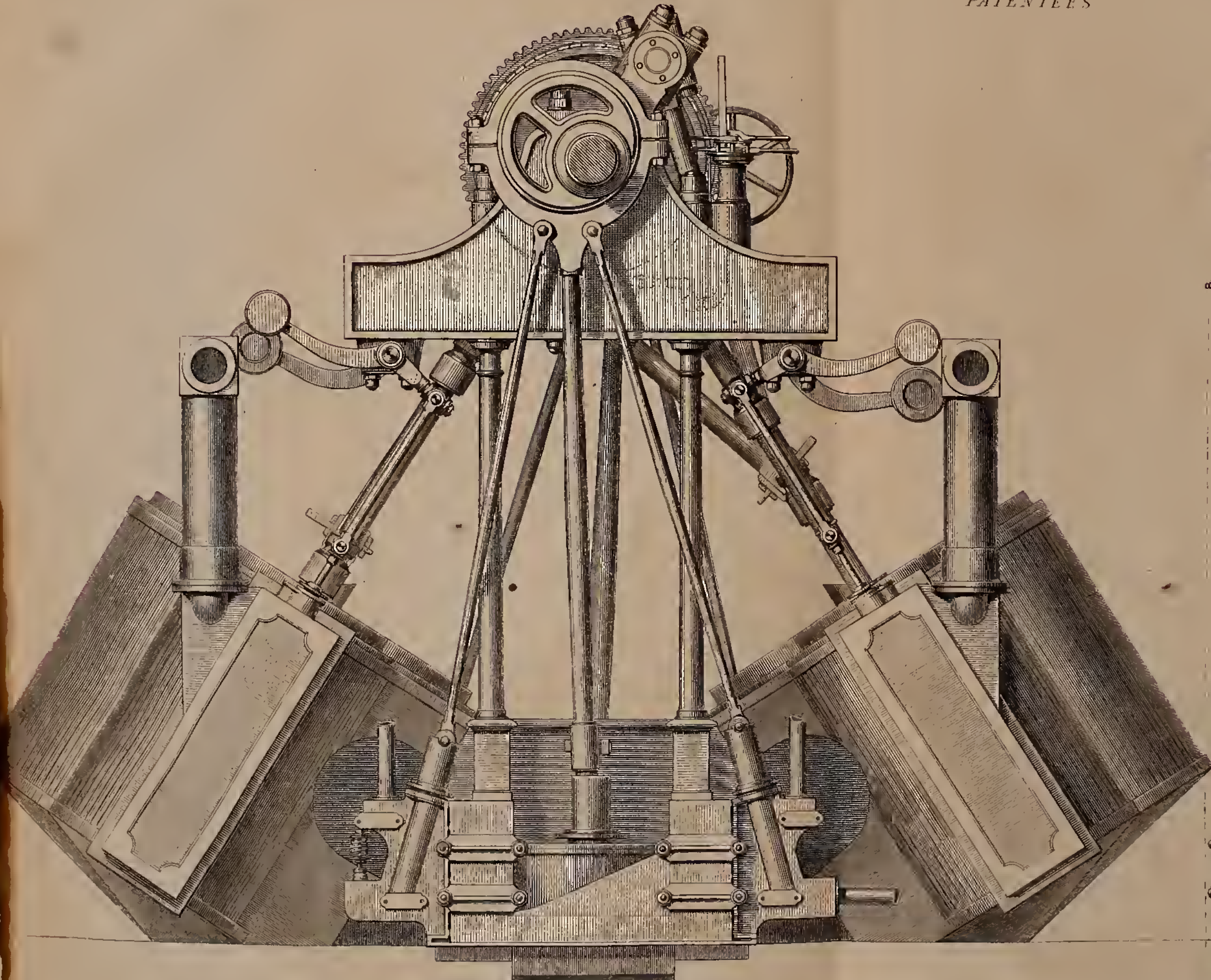


FIG I SIDE ELEVATION.

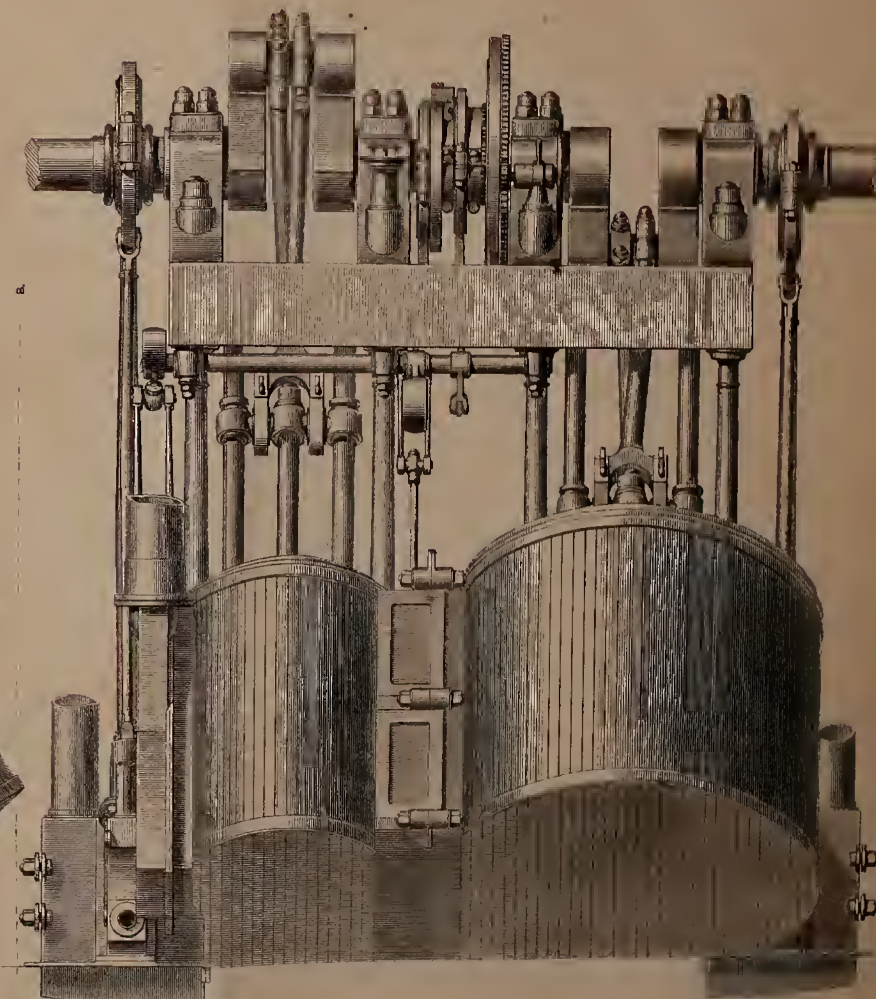


FIG 2 END ELEVATION, ON LINE A. B.

THE ARTIZAN:

A Monthly Record of the Progress

OF

CIVIL AND MECHANICAL ENGINEERING,

SHIPBUILDING, STEAM NAVIGATION, THE APPLICATION OF CHEMISTRY TO THE INDUSTRIAL ARTS, &c., &c.

EDITED BY Wm. SMITH, C.E.

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VOL. XI. NEW SERIES.

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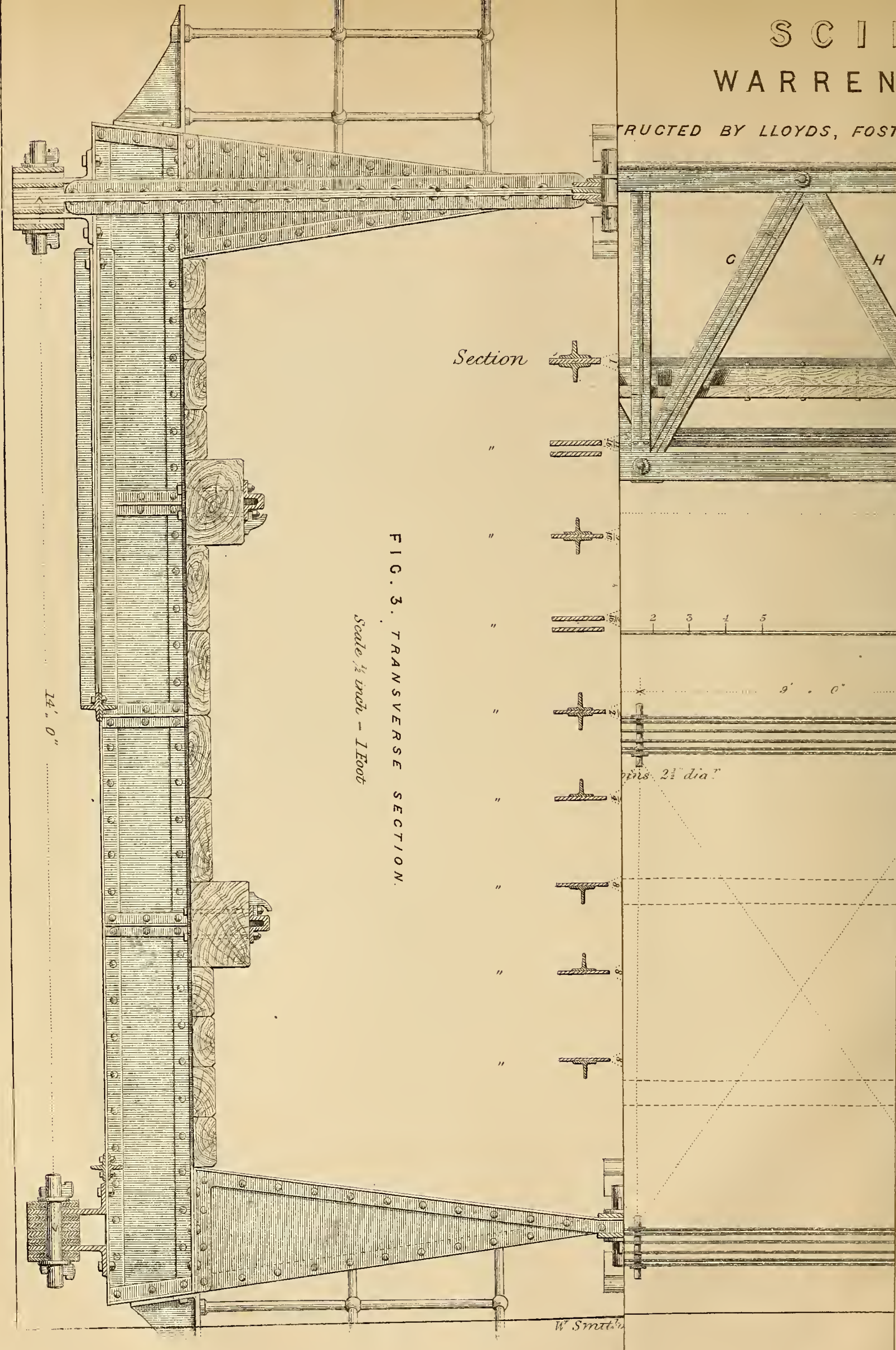
INDEX TO VOL. XVII.

THE ARTIZAN JOURNAL, 1859.

LIST OF PLATES.

TO THE BINDER.

Plate CLIII., Engines of the "Valparaiso," to face title page.

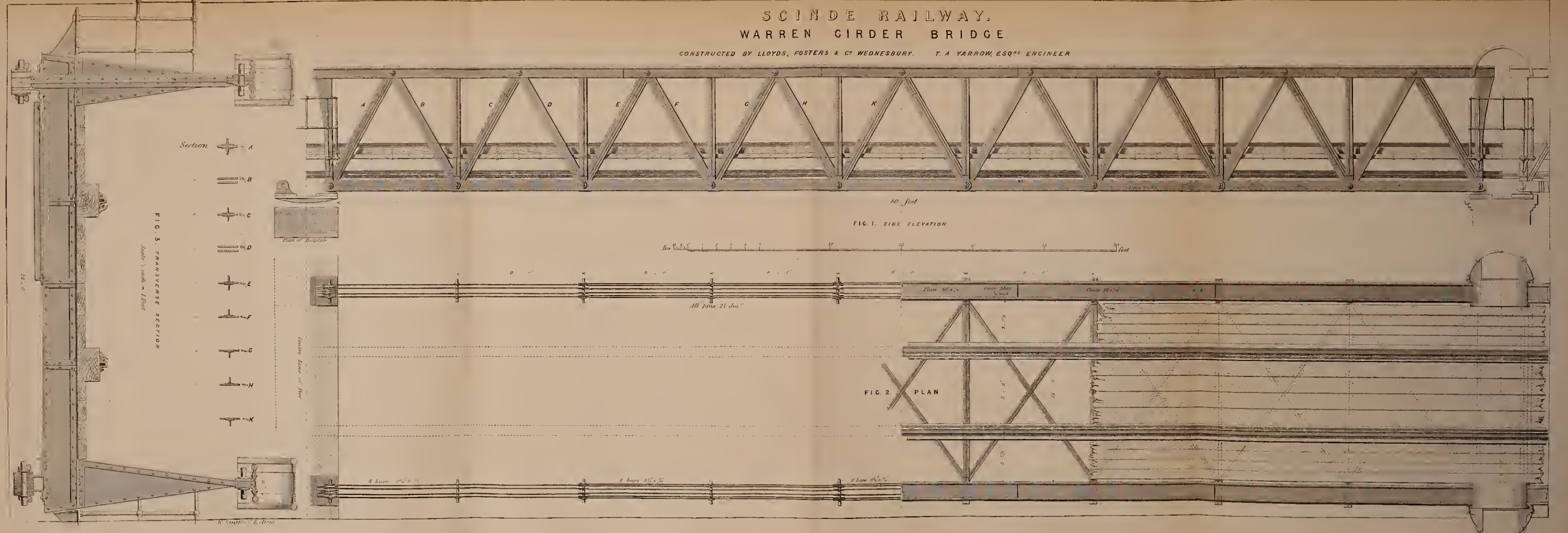


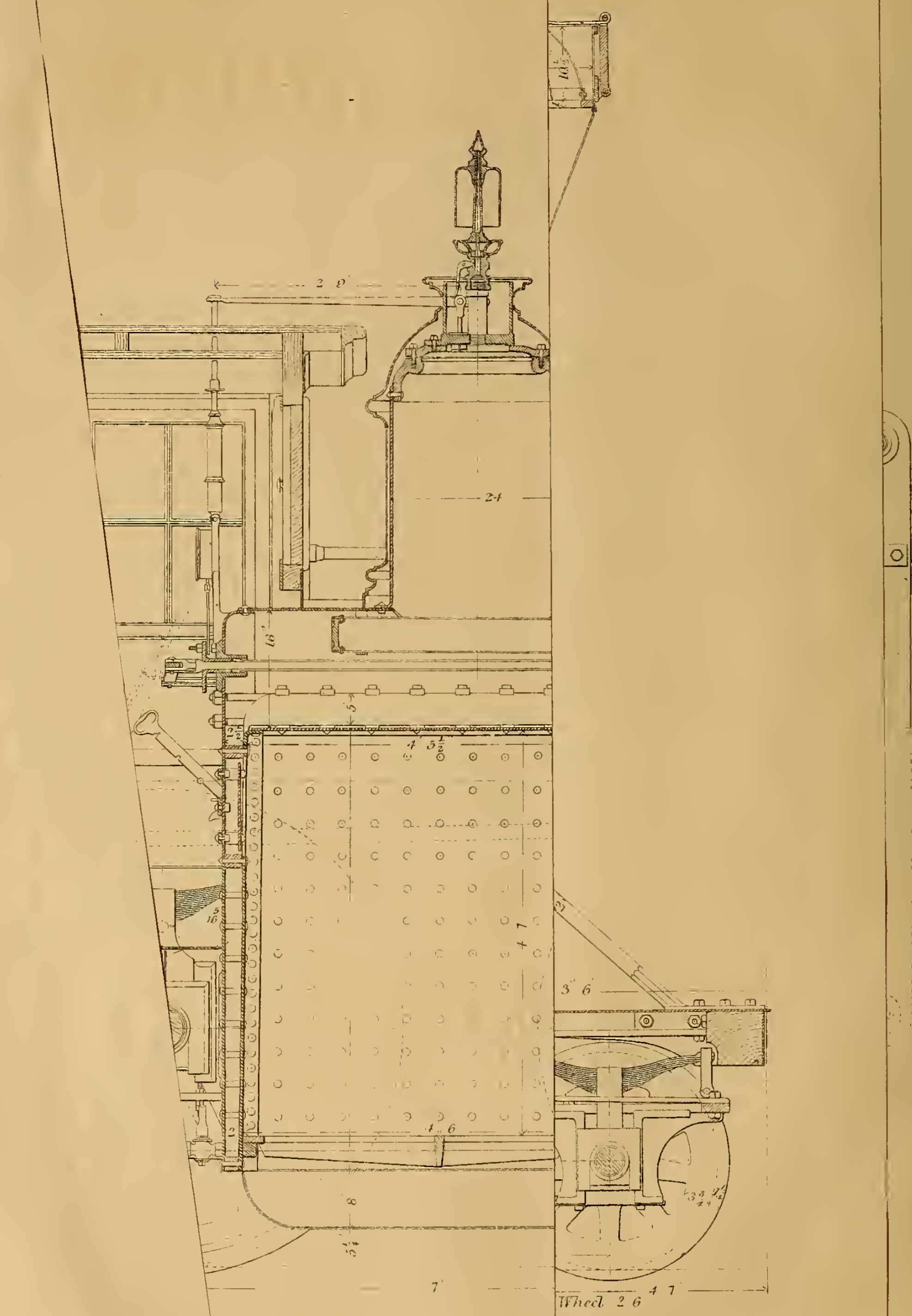
S C I
WARREN
RUCTED BY LLOYDS, FOST
C
H
Section
FIG. 3. TRANSVERSE SECTION.
Scale ½ inch – 1 Foot
14'. 0"
2 3 4 5
9'. 0"
pins 2½" dia."
W. Smith

SCINDE RAILWAY.

WARREN GIRDER BRIDGE.

CONSTRUCTED BY LLOYDS, FOSTERS & C° WEDNESBURY. T. A. YARROW, ESQ^RE ENGINEER

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THE ARTIZAN.

No. 192.—Vol. 17.—JANUARY 1st, 1859.

"ARTIZAN" ADDRESS, 1859.

In entering upon another year, we avail ourselves of the privilege, which we have for some time past annually assumed, of addressing to our readers a few observations at this period. We now pass in review some of the events and occurrences of the year 1858, and some of our own efforts during that period to cater for our friends and supporters. Let us hope such efforts have not been without considerable success,—indeed, we venture to believe that such has attended them.

We have also on former occasions availed ourselves of the opportunity thus afforded, to make some announcements as to our intentions for the further promotion of the objects and extending the sphere of usefulness of The Artizan.

Of what appears to us "looming in the future," and which we considered interesting to our constituents, we have, on like occasions, availed ourselves of the opportunity to say a few words. Not that we aim at affecting the prophetic, or even a greater share of ability to see further into either the future or *a mill-stone* than our intelligent peers; but we have occasionally, whilst indicating what to us appeared the possibles and probables of the coming time, shadowed forth matters which have, we believe, been usefully applied and made available in aid of advancement and material progress.

First, then, we have to express in unqualified terms our sincere gratitude to our greatly-enlarged circle of *substantial* supporters—constituents who have not merely voted for us, but have nobly come forward and paid the cost of our election. To these, our *annual subscribers*, we return our best thanks for their very prompt response to our invitations. To our subscribers generally we desire also to convey our thanks. To our world-wide-spread and highly-valued contributors and correspondents we are more than ever indebted, for their many and great kindnesses, and for the readiness with which they have during the past year imparted their quota of knowledge and useful information: such has, through the medium of our pages, been made useful to thousands of their fellow-labourers in the onward march of practical improvement and every-day life. We sincerely trust that we may continue to be favoured with their highly-esteemed communications.

To our very numerous friends who during the past year have availed themselves of us as a medium for acquiring information upon "a thousand and one" subjects, we say, right glad are we to find their faith in us, and in our responses, so well founded—whilst, however, we ask them never to spare us when we can be really useful to them, and by all means to avail themselves of our disposition to aid and assist whenever and wherever we can—we must beg some of our *young* friends to think, search, and work a little more for themselves before they claim our assistance; a very slight amount of pre-consideration would, in very many cases, render it unnecessary to make inquiries such as sometimes come to us of trivial, elementary, and, indeed, schoolboy character. The self-discipline and mental industry we here recommend to our young friends will, we can assure them, be highly beneficial to them. Without such inquiries at all the editorial postal replies to judicious correspondents in all parts of the world ordinarily involve twenty-five to thirty letters per month, many of considerable length, and often necessitating some research, frequently many inquiries, and always some consideration. All this is a pleasure to us when the objects sought are of a practically useful and serviceable character.

We are happy to be able to congratulate our friends and ourselves on our continued increase of circulation.

During the past year we have felt justified in increasing the number of pages, by which, and reducing the size of the types throughout, we have very materially increased the quantity of matter introduced in each Number.

The collation of the "Notes and Novelties" has had devoted to it, almost exclusively, the services of one of the editorial staff; and we are glad to perceive, from the numerous letters received from all parts of the world, that the introduction of this feature has been hailed with great and general satisfaction. We trust that those who have kindly volunteered the expression of their gratification, and others who have promised their quota of information—home, foreign, and colonial—will not fail to aid us in our endeavours to make this department of The Artizan still more useful. We assure them that every scrap of thoroughly reliable scientific information is highly prized; and let us add a reminder to willing individuals that, although items of information may by the parties themselves be thought to be only of local interest and of but small value, yet the continued and systematic collection and recording of such items are productive of the greatest benefit to a vast number of our inquiring fellow-workers. We say, therefore, to our readers, wheresoever they may be, and distributed as they are over the face of earth and sea,—Send us every scrap of information you can lay your hands upon, and as soon as you obtain it—there cannot be too many hands (aye, and heads too) engaged in "a good work." A good cause we well know it to be, and we do not hesitate in requesting this aid, nor will we falter in our efforts both to circulate its results and to render those results beneficial to our friends and the profession in general.

During the past year, as compared with any previous year, we have given with the twelve Numbers of The Artizan a greater number of, and larger-sized, copperplate engravings, of subjects which for interest have only been equalled by the plates (exclusively given by us) of the *Great Eastern* ship during the year 1857. We find on reference to our plate list for 1858, that twelve very large and expensive copperplate engravings were given. To this list we may add two other copperplate engravings of the same size as The Artizan page, which prior to the year 1855 was the ordinary and general size of the plates given; those, too, were generally, if not exclusively, but lithographs, possessing neither the fineness nor the accuracy of delineation which can be and has been attained by us in copperplate engravings. In addition to the twelve extra-large and two ordinary-sized copperplate engravings, we

WOOD-BURNING PASSENGER LOCOMOTIVE.

BY WM MASON & CO. _TAUNTON, MASS. U.S.

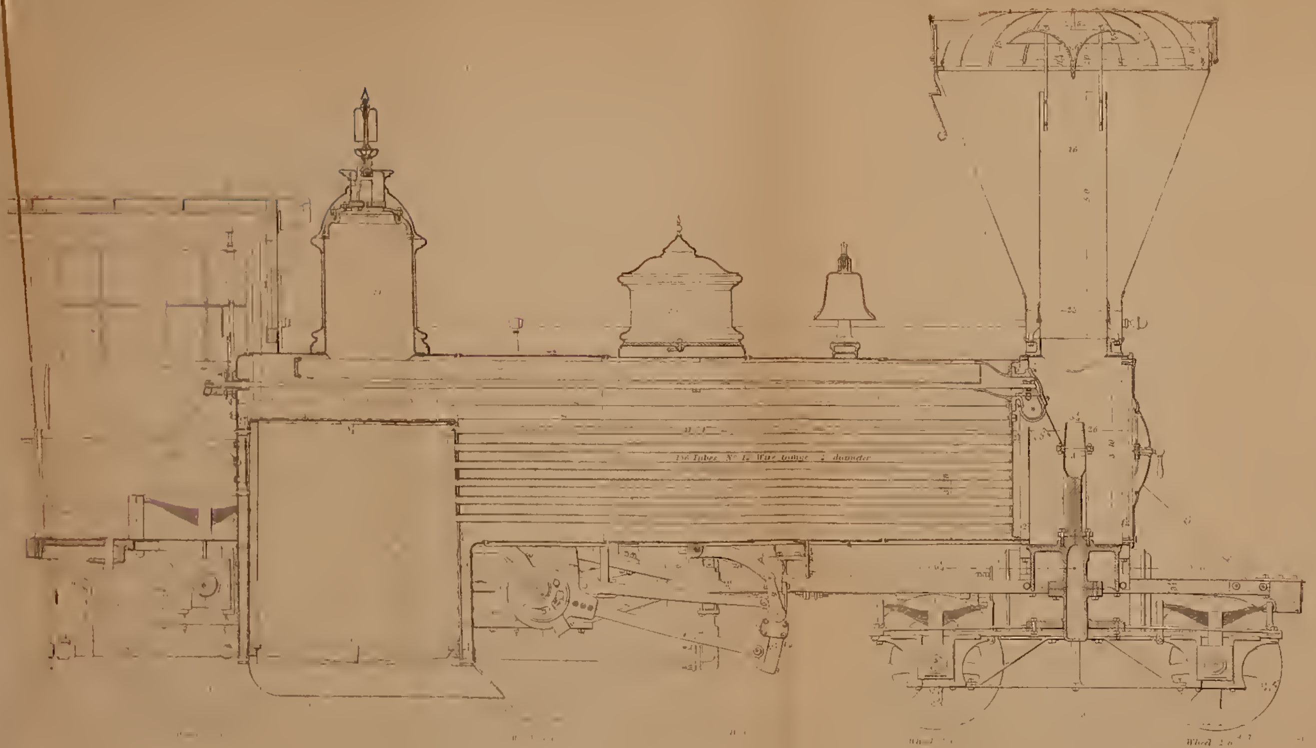


FIG I. LONGITUDINAL SECTION.

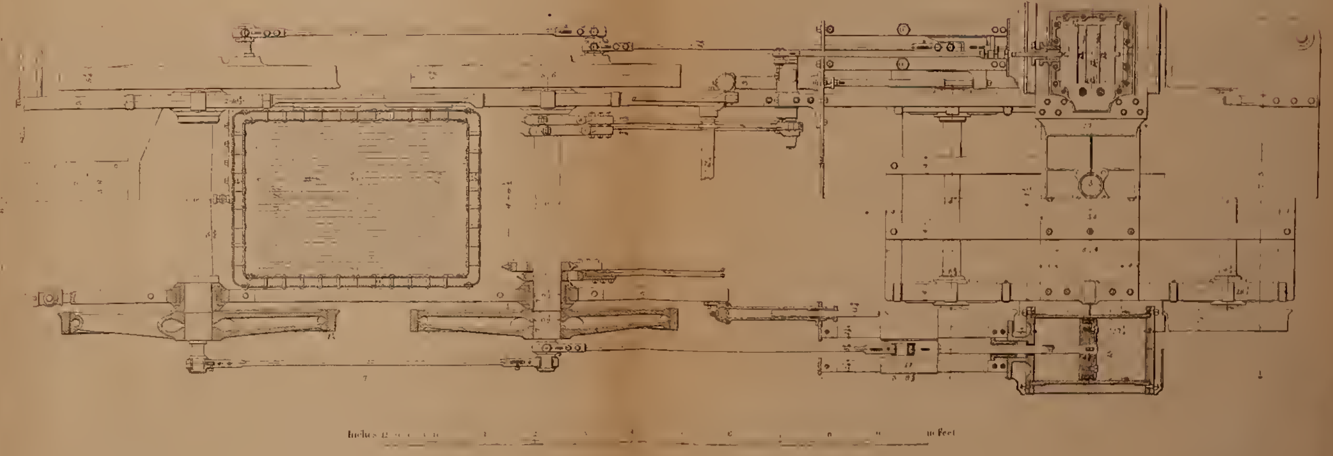


FIG 2. SECTIONAL PLAN

have given five large (principally double and frequently treble, and extra large) lithographs. In addition to the foregoing we gave with the Numbers for May and December a large sheet of transfers of illustrations, with the object of economising the letterpress portion of the Journal; for had we given as wood-cuts, in the body of The Artizan, the several illustrations, we should have deprived our subscribers and the public of from three to four pages of letterpress, which it would have been hard for us to have spared—hence our adopting this policy. These large sheets of lithographic transfers may have been mistaken by some of our less well-informed readers for very indifferently executed "Artizan plates;" but, as we explained on a former occasion, these sheets, although necessarily very inferior to the plate illustrations given by us, are useful, because, whilst they convey such a general idea of the subject as wood-cuts usually give, they economise our type space.

As to our future arrangements for extending the sphere of usefulness of The Artizan, and of carrying out more fully that which we undertake, we shall be materially guided by the extent of progressive support which we hope to receive during the current year. It is our desire either to further increase the dimensions of The Artizan in future (which must enhance the price), or publish a mid-monthly supplement on the 15th or 16th of each month, by which we shall be able to find an outlet for the vast fund of materials which each month is collected, and which at present requires the most ruthless excising, and an amount of selection and rejection which it is exceedingly difficult to perform with satisfaction to ourselves. On this, however, we shall hereafter, and at a very early period, take the opportunity of again communicating with our subscribers, and shall be materially guided in the course on which we shall determine by their opinions, which we now invite.

We now pass to a brief, and it must be but a very brief, sketch of the more important events of the past year, and a hasty glance at what we conceive will probably be the most interesting or chief features of the present year, in connection with engineering and general scientific progress.

We noticed the progress of the *Great Eastern* steam-ship step by step, including the unsuccessful attempt to launch her in the first instance. The beginning of the last year, however, saw her safely launched, although after considerable delay and enormous expense. The unfinished condition in which she has remained has been due to the great excess of outlay incurred in building and launching her, and the want of public spirit, which has prevented her completion and equipment for sea; but it is now anticipated that after the sacrifice which has been made by the original proprietors, no difficulty will be found in obtaining the funds necessary for sending her to sea. Indeed, whilst we write, we are informed that the capital of the new Company has been subscribed for, and a considerable amount paid up.

The Atlantic Telegraph Cable, which was successfully laid in the latter end of the past summer, has failed to maintain that condition of perfect insulation which is absolutely necessary to render it available for the purpose intended. It has been argued that the form of the cable is not that which is best suited to the conditions under which it has to be treated in the course of removal, stowage, shipment, and paying out; and although we do not say that no better form can be found, we decidedly say that no better form has yet been exhibited or made public. The question of Light and Heavy Cables was discussed in able Papers read before the Institution of Civil Engineers during the past year; abstracts of these Papers will be found in our columns. If our readers will refer to the volume for 1858, they will find several papers and communications upon the subject. Whatever form of cable may hereafter be adopted, whether protected by a series of wires laid spirally around the electric conductors, or plaited or braided round the core, the means of paying out the cable at sea must be re-considered.

In the War Department, considerable progress has been made in the manufacturing works and buildings requisite for producing in the best possible manner ordnance and war material of every kind. The Iron Ordnance Foundry has been at work for some time, under the able direction of Mr. John Anderson, the inspector of machinery to the War Department, to whose talent and ability we have on several previous occasions referred. It is hoped that a degree of excellence and scientific uniformity of production will be attained by the working of the Woolwich establishment, which, like the Small Arms' Factory at Enfield, rather aims at excellence and exactness of production than competitive construction in rivalry with commercial contractors, who will, however, be held in check, whilst they are aided by the experience gained in these public establishments, which should be esteemed by them as models, or examples to be followed.

In India the progress of public works has been resumed, and whilst the Directors of the late East India Company deserve the highest credit for the liberal spirit with which they had lately fostered public improvements in their dominions, it is to be hoped that the new Council of India under Her Majesty's Government will with still greater energy and promptitude foster and encourage the execution of useful and necessary public works; for in no part of the world can they be more usefully constructed, and with a fairer prospect of ample remuneration to justify the expenditure of capital; as by their means the extraordinary richness and productiveness of that enormous Empire will be opened out and made available; and in this we see an immense field for the employment of the talent and skill of the Engineer. We are encouraged in our anticipations of an enlightened spirit of Governmental administration by perceiving such eminent practical men as Sir Proby Cautley in the administration of Indian affairs.

Railway construction goes on, though slowly, yet steadily, throughout the Continent of Europe, and in the Eastern as well as the Western Hemisphere, and one of the chief fields of operation for railway engineers in Europe will be Spain and Portugal, after Russia and Germany, in which latter countries a vast amount of railway works have been projected, which are chiefly in the hands of foreign engineers.

Of bridges and viaducts in connection with railway works, nothing very novel is deserving of note beyond the approaching completion of the Saltash Bridge, and the Victoria Bridge at Montreal. The latter is progressing rapidly, and will be completed earlier than was expected.

In locomotive engine building and working:—Mr. D. K. Clark having again taken up his pen upon this subject, whatever is new and worth reading will be found in his new work now in course of publication. The coal-burning experiments still go on, and successfully, as it appears by Mr. Fothergill's report; and we may add that not the least successful are Mr. Beattie's experiments, witnessed by us, for substituting coal for coke as locomotive-engine fuel.

In permanent-way construction nothing very novel has been recently introduced. The necessity for roads being constructed entirely of iron continues to become manifest in an economic point of view; and when the necessary elasticity shall be imparted to the structure, by the interposition of permanently elastic material between the chair and the sleeper, by which the objectionable vibration will be checked, roads entirely of iron will become universally adopted.

The execution of tunnelling works by mechanical means is receiving practical trial in the piercing of Mont Cenis; and we have recently witnessed some practical experiments with machinery, designed for cutting stone of almost any degree of hardness, at a very rapid rate, and suited for the tunnelling and cuttings of railways and other works, which bids fair to succeed perfectly.

In Naval Architecture nothing very novel or interesting has occurred during the past year but that will be found in our "Notes and Novelties." An extremely interesting Paper upon Naval Architecture, by Mr. Reed, was recently read at the Society of Arts, and a very lengthy abstract of it will be found in our present Number. The introduction of steel plates, in the building of ships, is, we are glad to find, progressing; and several vessels of light draught are now building in the Mersey, in which Clay's puddled steel is being employed for the frame as well as the plating.

The various novelties in Marine Steam Machinery have been noted by us during the year, and we now call attention to what has been done in this branch of industry during the last few months; more particularly by Mr. J. Scott Russell, with his three-cylinder engines, worked at an increased steam pressure—by Randolph, Elder, and Co.'s engines and machinery of the *John Bell*, the *Valparaiso*, and other ships—by R. Morrisson and Co.'s *Omeo*—and J. B. Palmer and Co.'s *Hudson* and *Weser*—as indicative of the direction in which improvements in marine steam machinery are progressing. We may assume that the employment of increased pressure with cut-off and expansion, steam jacketings, surface condensation, feed-water heating, and superheating apparatus, together with a construction of boiler better suited to the more rapid and more economical generation of steam, at still higher pressures than have even recently been employed in connection with condensing engines, will be practically worked out and applied in combination. It is, however, to the sources of power—the boiler and its furnaces—that special attention should be directed.

The British Association have appointed a committee of scientific men of eminence, to consider and report what is in their opinion desirable for the more accurate recording of facts connected with the performance of steam ships, and which will involve investigations of considerable interest. If fully carried out this report will, we believe, prove of lasting benefit not alone to the constructors of marine steam machinery and steam ship builders, but also to the proprietors of steam ships.

In the application of steam machinery to agricultural purposes considerable progress has been made, and we may look forward to an immediate practical solution of the question of the respective economies of the various systems of steam tillage and cultivation. We consider that too much attention cannot be paid by agriculturists and growers of colonial produce throughout the world, to the thoroughly practical and very economic steam cultivator introduced by Mr. Romaine, as it performs with extraordinary rapidity and perfection the turning over of the soil, similar to, and as a perfect substitute for spade husbandry.

The meeting of the British Association for the Advancement of Science, held at Leeds in the month of September, was, to mechanical men, and others connected with the applied sciences, one of the most interesting meetings which has been held since the meeting at Glasgow. The next meeting is to be held in Aberdeen.

Those of our readers who are interested in the Metropolitan Drainage schemes will be glad to learn that there is some chance of the works being immediately commenced, and, it is to be hoped, prosecuted with vigour. The arrangements for pumping the sewage matter from one level to another involve the requirement of steam engines and pumping machinery, for which designs have been invited.

It is to be hoped that the lines of railway around the metropolis, and particularly the inner circle, by which the leading thoroughfares of the town will be greatly relieved, will be forthwith executed.

There are many other subjects on which we should like to add some remarks, if but a few words upon each, but the amplitude of our monthly budget of general scientific information, "Notes and Novelties," classified as it is under the various heads, for easy reference, renders it much less necessary than we formerly considered it, to take such an opportunity as the present, for entering upon any more extended review of past and passing events.

One sentence more and we have done. Let us assure our friends and supporters, that during the year 1859, no exertion shall be wanting on our part, to keep them well and early informed upon all subjects which may concern their interest or merit their attention; and it will remain with themselves to afford us such substantial support, as will enable us to do this, to the fullest extent we can desire. We may add, in conclusion, that we have in reserve for our immediately succeeding numbers, a valuable series of copper-plate engravings, now in course of execution, of important engineering works of the highest interest.

IRON GIRDER BRIDGES FOR INDIAN RAILWAYS.

(Illustrated by Plate No. 136.)

The importance of rapidly completing the Indian railways has developed many ingenious contrivances for saving labour and time; and none of them has stood more prominently forward for overcoming the difficulties and delays attendant upon crossing the rivers than the Warren Girder Bridge.

The accompanying illustration refers to spans of 80 ft., although by arrangement of material they may be constructed for openings varying from 50 to 200 ft.

By permission of Mr. Yarrow, the engineer to the Scinde and Punjaub Railways, we are enabled to place before our readers the Plan and Specification under which a large number of these bridges have been prepared for India.

The chief advantages of the girder are—facility of transport and erection, and the perfect uniformity of parts. So completely is this system carried out, that portions of various girders, indiscriminately taken from the bulk of material, are fitted together in the required spans.

A large number, constructed for the Scinde railway, were lately tested at the works of Messrs. Lloyds, Fosters, and Co., of Wednesbury; and the deflection averaged a quarter of an inch for each 30 tons placed upon the bridge.

The maximum load was 120 tons, and the greatest deflection 1 in.

Upon the removal of the weight the bridge recovered itself to within 1-32nd of an in., which set was fairly ascribed to the tightening of the pins, and bringing the parts to their proper bearing.

The late Mr. J. M. Rendel (no mean authority) in a "Report to the Directors of the East Indian Railway," stated—"I prefer bridges for India on this principle to those formed of tubular girders; and as the result of the experiments, made in my presence, proved to be entirely satisfactory, I am now in a position to recommend this description of bridge, without qualification of any kind."

Mr. Brunel, in his "Report upon the Victoria Bridges," observes, after referring to the trellis-bridge system,—"I cannot see any advantages that are not equally obtainable by Warren's girders, while the latter have the merit of disposing of the material theoretically in the most economical manner, and of being of a portable construction. Warren's girder is, I think, admirably adapted for many circumstances: it consists of many parts, which although they require some nicety of workmanship, may be finished at the manufacturers, taken to pieces, and sent to countries or localities where workshops could not be erected or artisans obtained capable of working metals, or even of doing boiler work, which is the simplest possible metal working."

Colonel Kennedy, the talented consulting engineer to the Bombay and Baroda Railway, has extensively adopted this description of bridging in connection with Mitchell's screw piles, and credit must be awarded to this gallant officer for promoting a system more calculated than any yet brought forward in aid of the economical and rapid completion of a network of iron which will shortly cover the face of India, beneath the magnitude of which the English railways sink into comparative insignificance.

SPECIFICATION FOR WROUGHT-IRON WARREN GIRDER BRIDGES, 80 FEET SPAN, FOR THE SCINDE RAILWAY.

T. A. Yarrow, Esq., C.E., Engineer.

General Description.—This specification refers to the construction of wrought-iron girders for 80 ft. spans, each span being formed of two wrought-iron girders, 83 ft. 4 in. long in the top flange, 8 ft. 5¼ in. deep, and 14 ft. apart from centre to centre, the ends being arranged to slide on cast-iron bed-plates fastened to the masonry piers. Each girder is divided into nine 9 ft. equilateral triangles. Each pair of girders is connected together by wrought-iron transverse girders 14 in. deep, cross-braced with T iron.

Wrought-Iron Work.

Rolled Bars for Horizontal Flange and Tension Diagonals.—The iron for the rolled bars forming the bottom flange and tension diagonals to be of such quality and make as shall be specially approved by the engineer, and the strength must be such as to withstand without breaking a tensile force of upwards of 25 tons per square inch, and of 12 tons per square inch without taking any appreciable permanent set. Sample bars will be selected by the engineer to be torn asunder in the presence of himself or his assistants, and should any of them break with a less strain than 25 tons per square inch, all bars similarly made will be rejected. Each bar must also be tested in a properly-constructed hydraulic machine up to 12 tons per square inch of section, and should the most careful observations show that any permanent set has taken place, such bar will under no circumstances be allowed to be used in the bridges.

The bars are to have their heads and central eyes rolled out of the solid bloom, and be of precisely the same thickness throughout. Under no circumstances will any welding on of the heads, or forming them by up-setting, or flattening out, or in any other manner, be permitted. The contractor shall also guarantee that the heads and pins are sufficiently strong to withstand the same strain as the bar. The holes for the main-pins to be bored with extreme accuracy to gauge.

No bar having an error in the length between the holes amounting to $\frac{1}{64}$ of an inch, or in the diameter of the holes amounting to $\frac{1}{100}$ of an inch, will be permitted to be used.

Top Flange Girder Struts and T *and* L *Irons.*—The top member of the girder and the diagonal struts are to be formed of bars and plates of best iron, or of other iron of such quality and make as the engineer shall approve. The top of the girder is to be formed of plates and angle irons riveted together in lengths as shown on the drawings, but jointed with joint plates attached by bolts.

The struts are to be formed of bars with T irons on the sides, riveted together, and shaped at the ends, and some of the rolled tension bars to have similar T irons riveted on them.

The holes for the main-pins in both top and bottom of struts are to be bored with the same accuracy and under the same conditions as described for the tie-bars.

Holes to be true with each other.—The holes in the two sides of the top are to be in true line with each other, so that the pins may be exactly at right angles with the plane of the girder.

Cast-iron Distance Pieces.—The cast-iron distance pieces between side plates are to be formed and connected with bolts as shown. All butt joints under compression are to be accurately and truly fitted, and care taken to allow them to bear well against each other over the whole surface.

Main-pins.—The main-pins are to be forged out of the very best scrap, Low Moor, Bowling, or other iron, approved by the engineer, and it must be attested by the certificate or invoices of the firms supplying the same.

They are to be turned perfectly parallel and exact to gauges; no error of more than $\frac{1}{100}$ of an inch in diameter will be allowed; the ends to be secured with split cotters and washers, and to be the exact sizes shown on the full-sized drawing.

Cross Beams.—The cross bearers supporting the roadway are to be made of the best Staffordshire plates and angle irons riveted together. The bracket pieces supporting the cross bearers are to be soundly forged out of good iron, and bored to fit the pins.

Diagonal Bracing.—The horizontal diagonal bracing is to be formed from best description of T iron, of the section shown on the drawing full size, the ends being carefully formed, punched, and provided with bolts and washers.

All bolts to be made of Low Moor or Bowling best iron, or such other iron as shall be specially sanctioned by the engineer. They are to be carefully forged and screened. All rivets shall be of S. C. Crown iron, or such other as shall be specially approved by the engineer.

The riveting generally is to be executed in a careful and workmanlike manner, the rivets thoroughly fitting the holes. Great care must be taken that the rivet holes exactly correspond; should any of them not be so they shall be rhymered out, as no drifting will be allowed.

The engineer may require any holes to be drilled, and the bolts turned for the same, or he may order bolts to be used in the place of rivets, or other changes of this kind, in any such places as he may consider necessary, without any extra charge.

Cast Iron.

Cast-iron Sliding Plates.—The cast-iron sliding plates to be made to the exact form shown on drawing. The cheeks or vertical parts are to be planed or filed to a perfectly even surface, each face being exactly parallel with the other, and of the width shown on drawing. The holes for the main-pins to be bored with great precision, to fit them, and be quite horizontal. The under side of this casting to have three projecting pieces ½ in. deep, which shall be planed truly horizontal to the cheeks. The slightest flaw or defect in the material or workmanship will cause absolute rejection.

Bed Plates.—The cast-iron bed plates to be of the form and dimensions shown on the drawings. Each plate to serve for the adjoining ends of two girders. Projecting pieces to be cast corresponding with the projections on the sliding plates, and these are to be planed perfectly even, and fixed truly horizontal.

Distance Pieces.—The distance pieces for the top member of the girders are to be cast and fitted as per drawing; and, if required by the engineer, a proportion of the holes on them shall be cast small, and afterwards bored to the required size.

Wood Platform.

Bolts and Hoop Iron.—The wood platform and guard rails are included in the contract; and all the bolts necessary for fixing the same must be provided.

Miscellaneous Work.

Threads.—All screw-threads used throughout the work shall be Whitworth's patterns.

Gauges.—Proper gauges for the sizes and distances of the main-pin holes in the various bars, for the main-pins themselves, and for any other parts which require accuracy and uniformity, shall be prepared by the contractor at his own expense, and submitted to the engineer for his approval, after which they must be carefully worked to.

Testing Apparatus.—The apparatus for proving the power of the resistance of the various parts to tension and compression, and for pulling asunder the sample tension bars, and of any other description required by the engineer, shall also be provided by the contractor at his own cost and charge; and he shall find all assistance necessary for the processes of testing, or for any other experiments the engineer may desire to try upon the works.

Erection and Proofs.—The engineer is to have the power of calling on the contractor to put every span together, complete, prior to shipment for India, if he thinks it desirable to do so; but, at the same time, if from his own opinion of the accuracy and uniformity of the work he may choose to dispense with the full carrying out of this condition he may limit the number erected. It is to be so arranged that each girder, when erected, and without other than its own weight, shall have a camber of 1½ in.

Each of the spans so erected must be proved, in the presence of the engineer or his assistant, in the following manner:—A temporary platform to be laid on the cross girders, upon which bridge-rails are to be fastened; upon these rails six trucks (not exceeding 10 ft. in length from extreme ends of buffers, and loaded to 20 tons each) to be pulled backwards and forwards over each span, as the engineer may direct, and the effect on the bridge to be carefully observed. Should this be unsatisfactory the Company may call upon the contractor to take any means their engineer may consider advisable, to correct defects existing in the work.

The contractor is to provide, at his own cost, proper foundations for erecting the spans upon, and all necessary arrangements and labour for the above operations, as the engineer may direct.

Marking.—The several parts of each span shall be distinctly and legibly marked with punch marks, or in any other form the engineer or his assistant shall define, so as to facilitate the putting together of the work in India. Complete references to the marks relating to all shall be prepared and forwarded to the engineer.

Painting, Protecting, and Packing.—The whole of the work must be carefully protected and packed, in such a manner as is satisfactory to the engineer, in order to preserve it from injury during a sea voyage to India.

The main-pins, and all other bright work, must be carefully coated with a composition of white lead and tallow, or such other preparation as the engineer shall approve; and these, as well as all other small or minute parts, must be packed in strong boxes well secured.

The heavier portions of the work must be painted immediately after being formed (and being previously well cleaned) with one coat of thin red lead paint, and subsequently with a strong coat of stone colour.

General Conditions of Contract.

Completeness.—The contract is intended to include the entire completion of the bridges and fixing them in India, and the provision of the whole of the ironwork necessary for the same. It is, therefore, expressly to be understood that all bolts, rivets, washers, and other minor parts, which may not be shown in the drawings, or mentioned in the specification, but which may reasonably be considered as being requisite for the proper completion of the work, are to be provided by the contractor, and included in the contract sum.

Quality of Materials and Workmanship.—The whole of the materials shall be of the best quality of their respective kinds, and shall be subject to the special approval of the engineer, who shall have power to prohibit any materials being used which he may consider unfit for the purposes for which they are intended.

The quality of the workmanship throughout, and more particularly in regard to the fitting of the main-pins, is to be of the most perfect description, and is to be more of the nature of that known as engine work, than such as is ordinarily employed on girder bridges.

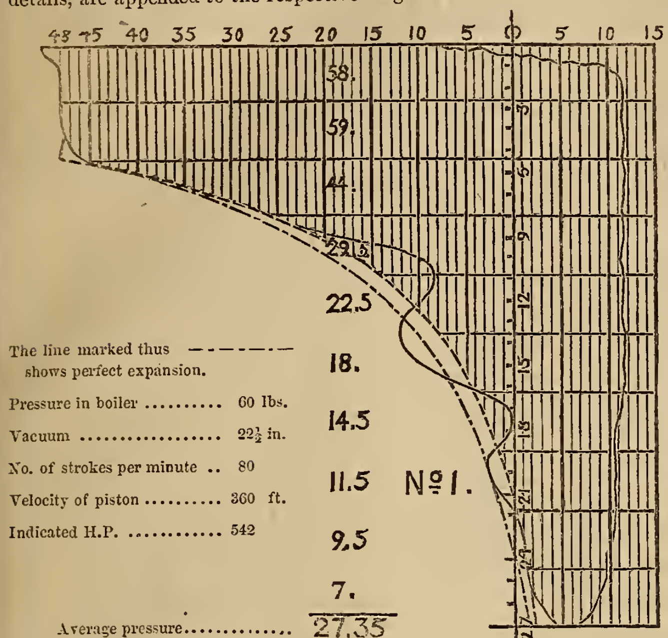
Contract.—The whole contract is to be executed in every respect in perfect conformity with the drawings to be furnished and this specification, and to the entire satisfaction of the engineer, who shall have the power to inspect, or of appointing a person to inspect, the entire manufacture, and of testing the work at any time during its progress in any manner he may think fit, and of rejecting all such portions as in his opinion are incorrectly made, or inferior in strength or quality; and in case any doubt or dispute should arise as to the meaning of any part of the drawings or specification, or as to the quality of work or materials, or any other matter or thing connected with this contract, the engineer shall have the power of deciding the same; and his decision shall be final and binding on both parties.

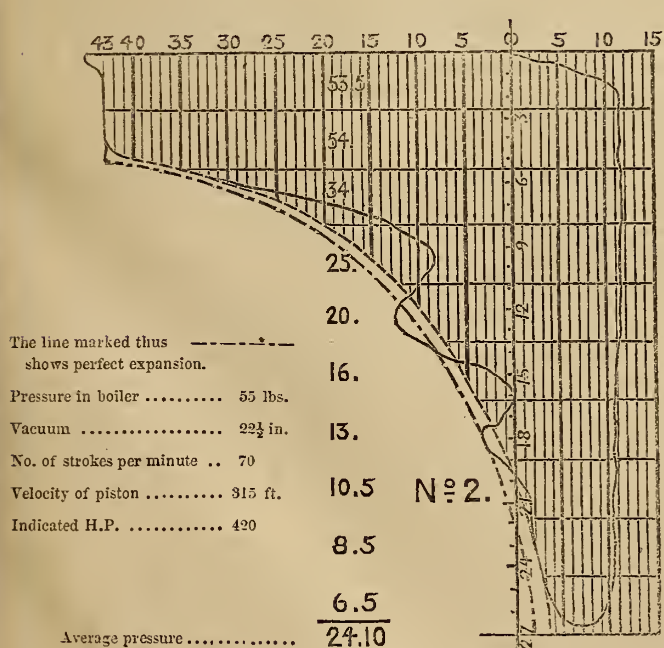
The contractor shall attend to and forthwith execute all directions in reference to the construction of the work which may from time to time be given to him by the engineer; and in case any slight deviations from the drawings or the specifications shall be considered advisable, the engineer shall have the power of ordering them to be done, and no extra charge shall be allowed for the same, unless the engineer shall agree to such extra charge in writing before the work it refers to is executed.

THE SCREW STEAM-SHIP "OMEO."

IN THE ARTIZAN for last month we recorded the trial trip of this ship, and gave her general dimensions. We are now enabled to give the accompanying indicator diagrams, which were taken during the trial trip referred to, in the presence of Mr. W. Langdon, C.E., of the firm of James Watt and Co.; Mr. Beckwith, on behalf of the owners; Mr. Leslie and Mr. Morrison also being present.

The indicator diagrams tell their own story, it being understood that as to diagram No. 1 and 2 the average pressures indicated, and the other details, are appended to the respective diagrams.





WE have thought it would prove interesting to a considerable portion of our readers if we published the specification of the *Omeo*. We now present the entire specification of the ship and her machinery, and we make good our promise to supply the indicator diagrams and calculations made during the trial trip before referred to.

The chief features in the performance of the ship on trial were the employment of steam at 60 lbs. per sq. in., and expanding it to a minus pressure of 9 lbs. per sq. in., or 6 lbs. below the atmosphere, with the engines going 70 strokes per minute.

SPECIFICATION OF AN IRON STEAM SCREW VESSEL OF THE FOLLOWING DIMENSIONS, AND CONSTRUCTED TO CARRY 900 TONS OF DEAD WEIGHT, UPON A DRAFT OF WATER 13 FEET. THE VESSEL TO BE PROPELLED BY A PAIR OF DIRECT ACTING MARINE STEAM ENGINES OF THE COLLECTIVE NOMINAL POWER OF 100 HORSES.

Built by Andrew Leslie and Co., Hepburn Quay, Gateshead-on-Tyne.

PRINCIPAL DIMENSIONS.

	Ft.	In.
Length between perpendiculars	212	0
Beam, moulded	30	6
Depth, moulded	17	6
Draft of water, with 900 tons dead weight	13	0

Keel.—Of best scrap bar iron, $7\frac{1}{4} \times 2\frac{3}{4}$ in., to be in as great lengths as can be procured, and to be connected together and to the stem and stern post by means of neatly fitted scarphs, not less than 22 in. in length.

Stern.—Of best scrap bar-iron, of same dimensions as keel, viz., $7\frac{1}{4} \times 2\frac{3}{4}$, moulded to the form of bow, which will be clipper.

Stern Post or Screw Frame.—To be forged in one solid piece, with a suitable boss for receiving the screw-shaft. The main post to be 8×5 in.; the after post to be $7\frac{1}{4} \times 2\frac{3}{4}$ in.; and the bottom to be 8×5 in., tapered to meet the thickness of keel, and be so constructed as to admit of the propeller being lifted on deck.

Frames.—To be angle-iron, $4\frac{1}{4} \times 3 \times \frac{1}{4}$ in., each side to be in one piece, and to be properly butted over the centre of keel. The frames to be spaced 18 in. apart throughout the vessel.

Reverse Frames.—Of angle iron, $3 \times 2\frac{3}{4} \times \frac{7}{16}$ in., to extend on every alternate frame to the upper deck, and on the intermediate frame to the upper part of bilge.

Floors.—Of plate iron $17\frac{1}{2}$ in. deep in the centre by $\frac{9}{16}$ in. thick, one to be placed upon every frame, and to have a proper limber hole for water-course.

Keelsons.—To be formed of plate iron $\frac{9}{16}$ in. thick and four angle irons $4\frac{3}{4} \times 3\frac{3}{4} \times \frac{1}{2}$ in., two on the top and two on the bottom edge, by means of which it will be firmly riveted to the double angle iron on the top of floors.

Side Keelsons.—To be placed at the floor ends, and to extend as far forward and aft as the shape of the vessel will allow; to consist of two angle irons $4\frac{3}{4} \times 3\frac{3}{4} \times \frac{1}{2}$ in. placed back to back, and riveted to the reverse frames and to the angle iron on the floors.

Beams.—Of patent bulb iron $7\frac{1}{2}$ in. deep $\times$ $2\frac{1}{2}$ in. thick, with two angle irons $2\frac{1}{2} \times 2\frac{1}{2} \times 5\frac{1}{16}$ in. on the upper edge, to be placed upon every alternate frame and well secured to ship's side by means of knee plates $\frac{1}{2}$ in. thick, and 20 in. deep.

Stringers.—A stringer plate, 2 ft. wide by $9\frac{1}{16}$ in. thick, to run all round the ship on the top of deck beams, to be well riveted to the angle irons of every beam, and to be connected with outside plating of vessel by means of an angle iron $4\frac{3}{4} \times 3\frac{3}{4} \times \frac{1}{2}$ in., which angle iron will also extend all round the vessel. Both plate and angle iron of the stringer plates to be in as great lengths as possible, and the butts to be well shifted. There will be a stringer plate of same dimensions riveted to the top of hold beam, and extending all round the ship.

Hold Beams.—To be placed, according with Lloyd's regulation for a nine years' class.

Stancheons.—Of round iron, $3\frac{1}{2}$ in. diameter, placed where necessary, and to extend from the centre keelson to the upper deck beams.

Bulkheads.—To be four in number; viz., one at each end of engine-room, one about the centre of the ship to divide the two cargo spaces, and one at the foreside of the forehold. All these bulkheads to be made of $\frac{3}{8}$ in. plate iron, and stayed with angle iron, $3 \times 2\frac{3}{4} \times \frac{7}{16}$, to be attached to the ship's side by a double frame, and the whole to be caulked and made watertight.

In addition to the above there will be a stuffing-box bulked aft, and a peak bulked head forward, running up to the lower deck.

Tie Plates.—To have a row of plates, 12 in. broad by $\frac{9}{16}$ in. thick, secured to the top of the deck beams. At width of the main hatchway these plates will be continued right fore and aft, and will be riveted to the stringer plate at bow and stern. To have on the top of hold beams an angle iron, $4\frac{3}{4} \times 3\frac{3}{4} \times \frac{1}{2}$, placed at the middle line, and running all fore and aft where practicable.

Bulwarks.—To be of iron, 3 ft. 6 in. high; the stancheons to be formed by every third frame of the ship being carried up, and to be plated with $\frac{1}{4}$-in. plate iron; to have an angle iron $3 \times 3 \times \frac{5}{16}$-in., riveted to the top edge for fastening the rail to.

Plating.—Garboard strake to be 2 ft. broad $\times$ $11\frac{1}{6}$ in. thick; thence to upper part of bilge $\frac{5}{8}$ in.; from bilge to shear strake to be $\frac{9}{16}$ in.; shear strake, $\frac{5}{8}$ in. thick, and bulwarks $\frac{1}{4}$ in.

The garboard strake to be connected with the keel by a strong angle iron 4 × 4 × $\frac{9}{16}$ in.

Riveting.—The keel, stern, stern-post, shear strake and bottom, up to turn of bilge, to be double riveted; also all stringer plates, tie plates, and vertical butts; all the rest to be single riveted.

WOODWORK.

Decks.—Main deck of yellow pine, 6 in. × 3 in., well seasoned and free from sap, shakes, or other blemish; to be secured to the beams with bolts and nuts.

Poop deck to be 6 in. × 2½ in.

Forecastle deck to be of yellow pine, 6 in. × 2½ in.; the decks to be caulked, planed and played in the usual manner.

Ceiling.—The fore and after holds to be ceiled up to the upper part of bilge with Baltic red wood 2 in. thick.

Waterways.—Of red pine 12 in. broad and 6 in. thick, secured to stringer plate with bolts and nuts, with felt between.

Rail.—Of American elm, 12 in. wide and 3½ iu. thick.

Hatchways.—To have two large cargo hatches; the coverings to be of oak, 10 × 4 in.; all necessary hatch covers, bars, &c., to be provided.

Catheads.—Of oak, 13 in. square, with three sheaves.

Knightheads.—Timber heads, bitts, mooring chocks, belaying pins, cleets, &c., of suitable size and streugth for the vessel.

Scuppers.—Four at each side, to be of large size and properly fitted.

Windlass.—Of English oak, with patent purchase of an approved principle.

Capstans.—To have one capstan on quarter deck and one forward, for warping the vessel, if practicable.

Pumps.—To have hand pumps to all the compartments of the ship, exclusive of engine room pumps; to be fitted with all necessary spears, breaks, &c., complete.

Compasses.—To have two neat mahogany binnacles, one on poop and one on deck house, with properly adjusted compasses.

Bell.—A large bell, to be supplied with handsome cast-iron stand, and ship's name engraved.

Steering Gear.—The steering apparatus to be of an improved pattern, with patent barrel, &c.; steering-wheel to be of mahogany, with brass mountings, rims, &c.

Boats.—To be supplied with four boats of suitable sizes, to be built of larch, and well finished; to have iron davets, falls, masts, oars, boat-hooks, &c., complete. One of these to be a life-boat.

Anchors, Chains, &c.—To be of the best quality, and properly tested, of number and size according to Lloyd's regulations for a vessel of this description and class; to be supplied with two mooring chains, ⅞ in., 30 fathoms each; on 7 in. hawser, 90 fathoms; one warp, 5 in., 90 fathoms; one warp, 2½ iu., 90 fathoms.

Chain Lockers.—To be fitted in fore compartment of sufficient size, with chain pipes, &c., complete.

Galley.—An iron galley, to be provided with cooking apparatus and all necessary utensils for sixty people.

Water Tank.—An iron tank for fresh water, to be fitted under the forecastle or cabiu floors, of as large size as the space will admit, with a pump, air-pipes. &c.

Ballast Tanks.—One amidships and one aft, to be built of ⅜ in. plate, and properly stayed with angle iron, and to be capable of containing sufficient water to ballast the ship.

Coal Tubs.—To have six iron coal tubs for discharging cargo, to hold 1 ton each.

Rigging.—The vessel to be rigged as a barque. The standing to be patent galvanized wire rope, to set up with lamyards and dead eyes. All running rigging to be of the best Russian hemp, or Manilla, and of such sizes as are suitable to the vessel. All necessary gearing, such as blocks, sheaves, tackling, &c., to be supplied by the builders, and the whole to be of the best quality.

Sails.—To have one complete suit of sails, including Coningham's patent topsails, two topmast studding sails, two lower ditto, and one set of boat sails—all to be of the best long flax canvas, with galvanized thimbles, one complete set of tarpaulins, masts, coats, &c.

Bunting.—To have one white ensign, one blue ditto, Burges' Union Jack, Blue Peter, and one complete set of Maryatt's signals.

General Arrangements.—The vessel to have a raised quarter deck, extending forward to engine-room; a neat cabin, to be fitted up for captain and officers, with table, sofa, seats, stove, looking-glass, &c., &c.; a steward's pautry, with the usual fittings, uteusils, &c.; a round house, to be built on deck, with accommodation for engineers and officers, having two water-closets, lamp room, store room, paint locker, &c. Accommodation to be provided for crew in forecastle.

Painting.—All the ironwork to have three coats of paint; woodwork to be neatly painted and grained in the usual manner.

In short, the vessel to be made complete and ready for sea in every respect, except the following articles; viz., bed and table linen, plate, nautical instruments, &c.

SPECIFICATION OF A PAIR OF INVERTED DIRECT-ACTING CONDENSING SCREW EXPANSIVE ENGINES, 100 H.P.

By R. Morrison & Co., Ouseburn Engine Works, Newcastle-upon Tyne.

Cylinders.—To be 34 in. diameter; stroke, 27 in. Pistons to have metallic spring packing; slide valves and expansive valves iu one steam-chest between the cylinders, or otherwise, as may be arranged; piston rods to have the guides forged solid upon them.

Condensers.—To be formed in the two back upright frames.

Air Pumps.—To be lined with brass, with brass buckets and valves, and to be of sufficient capacity: the valve and bucket cover to be of vulcanized india rubber, and the pumps to be provided with air valves.

Pumps.—To have feed and bilge pumps of sufficient capacity, and to be provided with vulcanized india-rubber valves and air valves.

Reversing Gear.—To be what is termed the liuk motion; the eccentric to have brass straps and malleable iron rods, and the engines to be reversed by wheel and screw, or otherwise, as may be arranged.

The Centre Shaft.—Will be what is termed a double crank axle, aud will have four bearings, distributing the strain of the engines more equally than three. This shaft will be 8¼ in. diameter, and will be made of the very best scrap iron: the aftermost bearing will be corrugated, to take the thrust of the shaft.

The Running Propeller Shafting.—Will be of best scrap iron, the couplings being forged on, running in suitable bearings, and having a proper metal stern bush, lined with white metal, to take the weight of the screw.

Bed Frames.—To be provided with strong cast-iron bed-frames, to carry the upright frames, cylinders, and air-pumps, and in which will be formed the bearings for the crank shaft.

Propeller.—To be of cast iron; diameter and pitch to be left for after consideration; to have lifting gear complete.

Boilers.—To have four cone-flue boilers, 5 ft. 3 in. diameter outside, and 17 ft. high, with domes, complete. The conical fire-boxes to be of the best Low Moor or Farnley iron, ⅜ in. thick; the shell of best crown plate, ⅜ in. thick. Chimney to be 36 in. diameter, of sufficient height, and double, to receive the feed-water for heating before entering the boilers. The chimney to be the same strength as the boilers where double. The bottom of the chimney to be provided with mud doors and blow-off cock. The boilers to be mounted complete, each with two safety-valves, one scum cock, one glass water gauge, two gauge cocks, one 3-in. blow-off cock, separate aud distinct from all other pipes communicating with the boilers aud the sea, and all necessary sludge and manhole doors; one of Bourdou's steam indicators, and tested to a pressure of 80 lbs. per square inch before leaving our yard, and to work at 50 lbs. per square inch permanently. Boilers and double chimuey to be covered over with felt and wood, and neatly hooped.

The Funnel.—To be of moderate height, to suit rigging, and 36 in. diameter, of the same rake as masts of ship.

Waste Steam Funnel.—Of copper, of suitable diameter, and length same rake as masts.

Donkey Pump.—Cyliuder 10 in. diameter, pluugers 5½ in. diameter and 9 in. stroke, provided with brass or vulcanized india-rubber valves, brass glands and bushes; to be supplied with steam from the engiue boiler, and to be connected with the bilge, the boiler, ballast tauks, the sea and fore and aft bulkheads, and provided with a hose pipe of sufficient length.

Sundries.—The cylinders to be provided with escape valves; the condensers with blow-through valves and vacuum gauges. Each boiler to be furnished with fire bars and bearers; feed, steam, and donkey pipes to be of copper; all cocks of brass, with brass glands and packed keys; all working bearings and stuffing boxes to have oil cups; the cyliuders to be carefully covered with felt, wood, and brass hoops.

Steam Cranes.—Two steam cranes, each with two cylinders, 8¼ in. diameter, and 9 in. stroke, with malleable iron post, deck plate, aud chain complete, copper steam aud exhaust pipes, with turning-round gear. Boiler to be cone-flued, 3 ft. 10 in. diameter, and 10 ft. high, with chimney and mountings complete, consisting of glass water gauge and Bourdon's steam gauge, safety, steam, feed, and blow-through valves, and small donkey to feed same, with tank for water, all fitted ou board complete, ready for use.

Conditions.—The builders to prepare the engiue, boiler, and donkey seats to our plans, and have the same ready, complete, before sending ship to crane for machinery; build coal bunkers, all hatches and combings, &c.; be at the expense of towing the ship to and from the Corporation crane to receive the machinery, and also be at all expense and risk (except breakage of machinery through defective material or workmanship) during the trial trip, except coals, oil, aud labour in engine room, which will be furnished by us, for working the engines. The builders to furnish us with plans and sections of the ship, to enable us to arrange our boiler funnel and pipes as soon as possible, and have the ship at the said crane four weeks before the time of delivery.

List of Outfit.—One vice and bench, six cold chisels, four smiths' chisels, six assorted files, one cast-iron oil tank in two divisions, one set of oil cans, assorted sizes, one tallow kettle, one engine-room lamp, four gauge glass lamps, four coal trimmers' lamps, one hand lamp, one set of fire tools and three shovels, one set of spanners and one shifting spanner, one lead, one iron, and one copper hammer, two scaling hammers, two scrapers and two tube brushes, three dozen assorted bolts and nuts, two ash buckets, one water bucket, one hose for engine-room, one hose for deck, connected with donkey, 60 ft. long, one set of pipes and cocks for watering bearings, one syringe, one salinometer, one spare screw, tank for waste water from waste steam pipe, portable forge and anvil.

AMERICAN WOOD-BURNING PASSENGER LOCOMOTIVE.

Constructed by Messrs. W. Mason and Co., Taunton, Massachusetts, U.S.

Illustrated by a large folding Plate, No. cxxxvii.

We regret to be compelled, at the last moment, to omit until next month the textual description of the above interesting Plate; we shall then be enabled to give a second Plate, illustrative of the same subject.

WHO INVENTED THE SCREW PROPELLER?

Nearly two months ago we received a pamphlet thus entitled, "Who Invented the Screw Propeller? Were the Patented Propellers of Francis Pettit Smith (formerly farmer, at Hendon, Middlesex), in every respect direct Plagiarisms?"

This title would naturally excite curiosity to learn the drift of these interrogatories, and so induce a perusal of the eighty-five pages of somewhat closely printed matter, which the author (a Mr. James Nicol, of Glasgow) devotes to the consideration of the subject. On proceeding to peruse the pamphlet, the first notable passage is a quotation from the treatise on the screw propeller, by John Bourne, C.E.; and then we discover, from the statement of the author which follows, "the object of the present publication is to prove, that the great merit heretofore ascribed to Francis Pettit Smith had never any foundation in fact."

This, then, is the avowed object of Mr. James Nicol's laborious effort. Nearly ninety pages of closely printed matter, accompanied by two large sheets, containing lithograph views of various descriptions of propellers and gearing,—and to what end we hope to be able very speedily to show.

We had thought that the excellent and elaborate historical works devoted to the subject of the screw propeller, by two such eminent men as John Bourne and Bennett Woodcroft, had placed before the world all that could be written or said truthfully and usefully, and that those who have sought to acquire reliable information, historical and practical, relating to this and other forms of marine propelling instruments or apparatus, had become familiarised with the prominent part which Mr. F. P. Smith has performed in connection with the introduction and gradual extension into use of the screw propeller; it has become "familiar as household words."

On proceeding with the perusal of the pamphlet it is difficult to say which feeling predominated,—surprise, disgust, or pity; but assuredly we felt pity, and regretted that any sane man should lend himself to the publication of a work so full of absurd and unfounded charges based upon imaginings of some distempered miud, without disclosing the slightest grounds for the inferences drawn, and upon which so grossly scurrilous a mass of fevered ranting and raving has been strung together.

The fate which we were at first inclined to believe this work merited at our hands was to consign it to the waste-paper basket, or if preserved therefrom, then only to be retained as a record of the extent of the abuse of the liberty of the press practised in England in the latter half of the nineteenth century, and also as evidence of the extent to which insanity in individuals is permitted unrestrainedly. Surely if Mr. James Nicol, whose name and address appear on some of the earlier pages, and elsewhere in the work, is not already properly cared for and under restraint, it must be that he has had that peculiar shrewdness which belongs to a certain character of insanity, to have sent all the copies of his pamphlet far south that his friends might not discover the truth; for unless Mr. Nicol is labouring under that terrible malady, which it is only humane and charitable towards him to suppose is the fact, he would certainly deserve the infliction upou him by the several parties libelled in his pamphlet of the legal consequences to which the grossly scurrilous, libellous, and defamatory statements therein contained should subject him.

After due consideration, we arrived at the conclusion,—that whether Mr. Nicol be mad or not, he has most industriously circulated his pamphlet extensively amongst those who are not perhaps so familiar with the facts connected with the introduction of the screw propeller, and with the important part which Mr. F. P. Smith has by all competent men of eminence in the engineering world had assigned to him indisputably in connection therewith, we have felt it a duty to take up the subject and deal with the charges which Mr. Nicol (whether sane or otherwise) has made against some of the parties more prominently mentioned in the pamphlet.

To expect Mr. F. P. Smith to condescend now to answer the charges made against him for that which more than twenty-two years ago any inventor who considered himself aggrieved or injured by the granting of letters patent to Mr. Smith had the opportunity which is afforded to all who chose to avail themselves of it, by opposing the granting or sealing of the letters patent; and, moreover, after Mr. Smith has remained in undisturbed possession for so long a time of the merit which was awarded, after due investigation by competent authorities, as justly belonging to him, we can thoroughly understand that he would be indisposed to take any trouble to disabuse the minds of those who may choose to attach any credence to the unfounded pretensions put forth by Mr. Nicol on behalf of others, and in detraction from Mr. Smith's just and indisputable claim to be considered as the meritorious and first introducer and able and persevering and successful advocate for the introductiou of the screw propeller as an efficient substitute for the paddle-wheels in steam-propelled vessels. Without desiring to be thought officious, or of seeking the office of champion on behalf of Mr. F. P. Smith and others, we have deemed it our duty to put ou record so much of what we of our own personal knowledge know of the early history of the screw propeller as will meet some portion of the allegations contained in the pamphlet, and we have further taken steps to obtain written statements under declarations from the several parties charged by Mr. Nicol, and also have searched amongst the records and proceedings of the Society of Arts and elsewhere for refutary evidence in support upon points with which we are not prepared to make statements from personal knowledge.

It should be premised that Mr. Nicol in the three sections into which he has divided his scurrilous effusion, first charges Mr. F. P. Smith "with incapacity to invent, and inability to introduce the screw propellers ascribed to him;" he then gives what he describes "a narrative of the origin, development and primary introduction of a series of screw propellers in Irvine, Ayrshire;" and next sets forth "the manner and evidence of the extraordinary piracy of these propellers by Andrew Smith, Engineer, London, who is believed to have been the real author of F. P. Smith's patent." Now, as to the first section, we need only refer such of our readers as are not already familiar with the history of the introduction of screw propellers, to the excellent works of Mr. John Bourne, C.E., and Mr. Bennett Woodcroft; in each of which the subject has been so ably and fully treated historically and practically, as to fully and fairly put that part of the subject in an indisputable and entirely reliable position, and nothing which Mr. Nicol brings forward in his pamphlet in anyway disturbs;—the conclusions which he desires to arrive at, he altogether fails in supporting; and of this we shall hereafter afford some conclusive evidence.

As to the second section, much that is contained therein is irrelevant to the real questions involved, and which if entirely true simply amounts to this—that Mr. James Steadman, a carpenter and cabinet-maker, in Irvine, unacquainted with what had been done by others long before the date which Mr. Nicol selects as the period of Steadman's experiments with a theoretical screw propeller, conceived the idea that a screw might be employed for propelling a vessel through the water; and he states that, in 1827, an experiment was made with a three-bladed propeller fixed in the stern of a model-boat; and that this was effected with the co-operation of a Mr. McCririck and a Mr. Maxwell Dick, of Irvine. However, it is by no means made evident or satisfactorily proved that the date of these experiments was as early as Mr. Nicol asserts: it is however stated, at page 43, "that the working model with which most of the experiments were made, was at an early period of the work christened the 'Archimedes' by William Muller, Esq., a gentleman unconnected with the invention, and who is still living."

At pages 44 to 51 an account is given of the first attempt made by Mr. Dick (one of the parties associated with Mr. Steadman) to introduce the screw propeller to Captain Ross, in the years 1828 and 1829; and it is stated at the end of the latter year, a model with three kinds of screws was sent to the Royal Scottish Society of Arts, Edinburgh, accompanied by a descriptive paper, from which passages are cited, and copies of correspondence, dated January, 1830. It is next stated, that after the rejection of the model and paper by the Scottish Society of Arts, Mr. Dick visited London, and, through the introduction of Mr. Andrew Smith, a model of a boat fitted with a screw propeller was submitted to the Society of Arts, in the Adelphi, about December, 1830; that they were submitted to the Mechanical Committee of the Society of Arts, and the plan was reported upon unfavourably.

In the third section, Mr. Andrew Smith, who had introduced Mr. Dick and the screw model to the Society of Arts about the middle of December, 1830, is stated therein to have invented Ducks'-foot Propellers—the patent for which was sealed 22nd January, 1831; and several of the patent inventions of Mr. Andrew Smith (such as for wire-rope, dated 1835, and other inventions equally unconnected with screw propulsion), and the charges made against Mr. F. P. Smith and Mr. Andrew

Smith are brought forward, quite irrespective of any relation to the *gravamen* of the charge of conspiracy and collusion between Mr. Andrew Smith and Mr. F. P. Smith, as will be evident when we cite the solemn declarations of each of these parties, that they were and still are, as the fact is, personally unacquainted with each other.

After giving extracts from a number of the Patents for Inventions by Mr. Andrew Smith, Mr. Nicol endeavours to prove—but by what process of reasoning he does not favour us by stating, but in the most unjustifiable manner proceeds to charge Mr. Andrew Smith; first, "with intimate and long participation in the invention patented in the name of F. P. Smith, and asserts that he had a substantial interest in its practical introduction ; and it is argued that because Mr. Andrew Smith obtained a patent for the Ducks'-foot Propeller that therefore he had availed himself of the knowledge of the Irvine model, and communicated to Mr. F. P. Smith an accurate description of it; and, it is suggested, induced him to patent it in the year 1836,—more than five years, be it remembered, after the model of the Irvine propeller had been exhibited at the Society of Arts.

It is furthermore asserted; first, "that Andrew Smith constructed at least one of the models of F. P. Smith, and fitted it with the necessary gearing and propeller :" second, "that Andrew Smith was the custodier of what seems to have been the exhibition model of F. P. Smith as late as the summer of 1841."

Furthermore, it is attempted to prove, "that Andrew Smith framed, or at least had a very important hand in the framing of F. P. Smith's novel and comprehensive specification," &c.: "that Andrew Smith, at and immediately subsequent to the date of the patent, possessed sufficient personal influence to obtain for the invention the co-operation of influential men, and particularly of the Lords of the Admiralty; while F. P. Smith, on the contrary, seems to have possessed none of the means necessary therefore;" and finally, "that Andrew Smith had anticipated a substantial interest in the whole screw-propeller invention."

In support of these grossly fabulous assumptions Mr. Nicol proceeds to cite a number of documents, which have about as much relation to, and bearing upon, the question as they have upon the cause of the failure of the Atlantic Telegraph Cable, or any other subject; and their connection with, and the attempts to apply them as evidence in support of the charges made against Messrs. F. P. Smith and Andrew Smith are so self-evidently illogical, not to say absurd, that no sane man would for one moment admit their applicability. But to put beyond a doubt, and for the purpose of making apparent the total absence of truth in Mr. Nicol's statements respecting the two gentlemen who are so grossly assailed, we have in this instance stepped out of our usual course as journalists, and applied to Mr. F. P. Smith and Mr. Andrew Smith respectively, for answers to a series of questions submitted to them relative to the matter. We have, also, sought information elsewhere, upon such other points as we thought likely to be elucidatory of truth.

The following are the replies which Mr. F. P. Smith has forwarded to us, under a solemn declaration:

Declaration of F. P. Smith, in Answer to certain Questions put to him.

1st.—That I was born in 1808, and brought up in the seaport town of Hythe, Kent, and not in any inland county, as stated in Mr. James Nicol's Pamphlet, page 30.

2nd.—That I was always addicted to the making and sailing of model boats.

That I preferred, from my earliest years, the study of mechanical subjects to other amusements;—that I became, in consequence, aware of the principles and power of the screw as applied generally in mechanics ; and, from personal observation, its effect in raising water on a large scale during the construction of the foundation of a bridge in the Military Canal, at Hythe.*

3rd.—That I was in the habit of spending much of my leisure time in a windmill, whilst at a school in Ashford, Kent (the Rev. Alexander Power, proprietor), and that I there took particular notice of the contrivances for turning the mill-cap and sweeps to the wind.

That the frequent consideration of these and other circumstances, combined in later days with occasional trips in the London steamers, led me to think that if a screw of suitable dimensions could be so applied to a vessel as to be totally submerged and driven at a considerable velocity, it would, by its peculiar action on the water, force the vessel forward or backward according to the direction in which the screw was turned.

4th.—That I constructed, as early as 1822, a model boat with paddle-wheels, moved by a roughly-contrived clockwork.

5th.—That I constructed a second clockwork model on a larger scale, with paddles, in 1830, at Hythe.

6th.—That I used the same experimental model from time to time at Hythe and at Hendon (situated about 6 miles from London), till 1834; during which year I re-arranged the said clockwork † to suit another boat, which I had made and fitted with a screw of $2\frac{1}{2}$ turns, taking as my pattern that portion of the *Archimedes* screw pump, which I had formerly seen at Hythe, placing it in the after part or deadwood of the said boat; the *first* experiment with this particular screw having been made in an oblong box, in the month of May, 1835, on my horsepond at Hendon.

* The instrument I then saw was called the Screw-pump of *Archimedes*.
† The springs and other portions of two old roasting jacks.

7th.—That I continued making experiments at Hendon and other places with various modifications of screws, adapted to an improved and larger clockwork model (still in existence) till May, 1836; when I was enabled by the pecuniary assistance of John Wright, Esq., banker, of Henrietta Street, Covent Garden, and Charles Andrew Caldwell, Esq., to take out a patent in my own name, on the condition that those gentlemen should claim jointly one-third of the proceeds of my said patent.

8th.—That I had never seen or read, or heard of any kind of screw being applied as a propeller to vessels at the date of my own experiments in 1834 and 1835, nor at the time of the sealing of my patent in 1836.

9th.—That the most eminent man of the day, on patents (Benjamin Rotch, Esq., of Furnival's Inn), was consulted by Messrs. Few & Co., solicitors, Covent Garden, as to the novelty and general merits of the invention prior to taking out my said patent. That the drawings and specifications of such patent were prepared by that gentleman, and to the best of my belief submitted to counsel, prior to their being finally deposited at the Patent Office.

That the disclaimer, memorandum of alteration, or reduction of my claims in the patent, were advised and carried into effect by the said Benjamin Rotch, in conjunction with Messrs. Few and Co., on behalf of myself, Wright, and Caldwell.

10th.—That I had not the slightest knowledge of the existence of any person by the name of Andrew Smith, until he was employed by Mr. Henry Wimshurst, contractor for the building and fitting of the *Archimedes*, to supply the wire rigging of that vessel; and I believe that Andrew Smith was equally unknown to each and every one of my friends at the time I have just referred to, and is still unknown by them.

11th.—That Andrew Smith had nothing whatever to do, directly or indirectly, with the drawing of or the alteration of the specification of my patent.

That I never received from Andrew Smith, or through his means, nor did I from any other person receive the suggestion, either in all or in part, of the idea of the application of the Archimedean screw to the propulsion of vessels.

That Andrew Smith was never employed or requested to make any drawing or model for myself or my friends associated in the patent; and that Andrew Smith, referred to, was on no occasion or pretence whatsoever entrusted with the care or charge of any model or models belonging to myself or others in any way connected with or interested in my patent.

12th.—That Messrs. George and Sir John Rennie had nothing whatever to do with myself, or my patent, or the undertaking in any other way, until applied to by me on behalf of the Directors of the Ship-Propeller Company, as their manager, to make a set of engines for the *Archimedes* in the spring of 1838, at which time those gentlemen took ten shares in the Company of £100 each.

13th.—That each and every model of boats' screws or machinery were, up to 1837, arranged and constructed by my own hands, including the first screw of two entire turns, as fitted to the 6 tons boat;* and that after that time I was greatly assisted by my firm friend and adherent, Mr. Thomas Pilgrim, in all matters connected with my undertaking.

14th.—That Andrew Smith was not in any way, directly or indirectly, connected with or interested in the Ship-Propeller Company, beyond the supplying of certain wire rigging to Wimshurst's order, as before stated.

I further, and lastly, declare that I had never seen, read or heard of any experiments on the propulsion of vessels being made at Irvine or elsewhere by Steadman, McCririck, Dick, or others, until I read of them in certain Scotch papers which were sent to me by a friend in London in the months of June or July last.

I desire, also, to state that no alteration, experiment or trial whatever of the 6 tons experimental boat were made, except in my presence and under my own personal superintendence.

That no alteration, experiment, trial or voyage whatever of the *Archimedes* was made by, or on behalf of, the Ship-Propeller Company, except in my presence and under my own personal superintendence.

That from the formation of the Ship-Propeller Company I invariably fulfilled the office of its acting manager, and that I at no time retained a less amount of interest in its affairs than one-fifth in the shape of shares and anticipated proceeds.

That I was almost constantly employed between the years 1840 and 1851 by the Government in the superintendence of the construction and fitting of screws to Her Majesty's ships, in addition to a large number of ships of various classes in the Merchant Service. That Her Majesty's warrant for my pension on the Civil List states—"Whereas we are graciously pleased to grant and allow to Mr. Francis Pettit Smith a yearly pension of two hundred pounds, in consideration of his great, *and for a long period* GRATUITOUS EXERTIONS connected with the introduction of the screw propeller into our naval service."

Guernsey, Nov. 22nd, 1858. Francis Pettit Smith.

[We regret that we are obliged to postpone the completion of the notice of this subject until our next.]

THE "HUDSON" AND THE "WESER" IRON STEAM SHIPS

In our "Notes and Novelties" for December, an error occurs in describing the *Hudson* steam-ship, burnt at Bremen-haven, as an American-built ship.

The *Hudson* was built by Messrs. Palmer, Brothers & Co., with engines and machinery by Messrs. J. B. Palmer & Co., of Jarrow-on-Tyne; she was delivered in August last, and had made one very successful voyage to New York and back, and was about to proceed on a second voyage, when the fire occurred.

A sister ship, the *Weser*, of exactly the same dimensions, lines, and power, was built and engined by the same firms, and was delivered on the 8th of

* This screw, which measured 2 ft. diameter and 4 ft. in length, was cut out of a solid piece of elm timber grown on my farm at Hendon.

November last. The following are some of the principal dimensions and particulars of the *Weser:*

	Ft.
Length over all	345
Length between poops	318
Breadth	40
Extreme depth	34

First saloon, 70 berths; second saloon, 105; emigrants, 397.

Engines—two cylinders 90 in. diameter, 3 ft. 6 in. stroke; tubular boilers, working pressure, 25 lbs. per square inch

On the official trial-trip, of 40 nautical miles, this vessel averaged $13\frac{1}{3}$ knots, and the certificate given by the owners' agents and engineers was, that the vessel had for a run of 40 miles averaged $13\frac{1}{3}$ knots per hour, at the consumption of coal of 3,689 lbs. per hour. The bunker-doors were shut, and watched by agents of the Company, and all the coals consumed on the three hours' run were weighed and lowered from the upper deck to the stoke-hole. The vessel was partly laden, having 1,500 tons of coal and iron on board, drew 18 ft. 6 in. water, with a displacement of 3,427 tons.

The following are the accurate details of the trial-trip measured runs just referred to:

The run was made from the mouth of the Tyne to Coquet Island, against the tide which flows along the coast to the south at flood, and back from Coquet to the Tyne with the tide; in turning the vessel the engines were kept at full speed, so as to test accurately the consumption of fuel. The total time was 3 hours 10 minutes, at full speed. The distance from the Tyne to Coquet was measured $19\frac{1}{4}$ knots. The tide was flowing south, and the vessel ran north against and back with, and arrived at the mouth of the Tyne about half an hour before high-water, so that, if anything, the tide was more against than with the ship.

The vessel was on an even keel, 18 ft. 6 in., and the greatest immersed mid. sec. was 606 sq. ft. The engines are of the direct-acting inverted kind; the cylinders are merely covered with many thicknesses of felt, and secured with mahogany. The steam-pipes and boilers are likewise coated; the feed-water is taken from hot-wells of air-pumps; the steam was, on the trial-trip, 25 lbs., always cut off 8 in. or $\frac{8}{42}$. The connecting-rods are five times the length of the crank; condensers, extra large; vacuum steady at 28 in. There were four boilers, each with six furnaces. The total area of fire-grate was 330 sq. ft. The tubes were $3\frac{3}{8}$ in. outside diameter, 7 ft. long. Total heating-surface of boilers, 11,500 ft. The consumption of coal was nearly perfect and free from smoke.

It may be worthy of note, that these vessels were contracted for under stipulations of speed and economy of fuel of no ordinary kind. No official trial-trip of the *Hudson* took place similar to that of the *Weser*, now described, owing to unfavourable weather. The Company agree that the trial-trip of the *Weser* was to be binding on both vessels.

It is needless for us to mention that in these very stringent contracts every point was watched by the Company's agents to get at the true result, and they have certified those now proved.

We consider the above trial to be highly interesting, and certainly most satisfactory to all parties concerned.

STEAM-SHIP "CLEOPATRA."

This vessel is the property of the Prince Il Hamy, Pasha of Egypt and Constantinople. She is one of a fleet of steam-ships belonging to one of the most enlightened and enterprising among the young Turkish princes. The vessel is remarkable for its form, its structure, and its machinery, as well as for its destination.

Il Hamy Pasha is the son of the late Viceroy of Egypt. He it was who landed in this country for a few hours, only to hear of his father's death, and to return to Egypt, where he possesses extensive private property and large landed estates, on which he encourages the culture of sugar, cotton, and corn, and by an enlightened system of management obtains a princely revenue. No man is more beloved by his people, or takes a deeper interest in their welfare than Il Hamy Pasha.

It will readily be understood from this description that the Sultan in selecting from among the youth of his empire the most eligible matches for his daughters, should have fixed on His Highness for one of his sons-in-law, and in the beginning of last year his nuptials were celebrated with great pomp by the Sultan at Constantinople.

It will thus be seen that His Highness is one of those Turkish princes who still retain the dignified position of living on their own independent revenues, without burdening the finances of the State. But he does more than this; he has become the owner of large steam vessels, which he employs in the commerce of Constantinople, and which have been conducting a large and profitable trade.

The *Cleopatra* is, we believe, the third steam vessel which has been constructed for His Highness by Mr. Scott Russell. She is a passenger vessel, intended to run between Constantinople and Alexandria, for the purpose, it is understood, of keeping up the communication of His Highness with his properties in Egypt, and which he frequently wishes to be able to visit in person.

The *Cleopatra* is 440 tons, and has paddle-wheel engines of 150 horses-power. Even with this moderate proportion of power to tonnage she has a speed of about 17 miles an hour, being the greatest speed hitherto obtained by any vessel of her class.

The peculiar shape of the ship is that known as the wave form, constructed on the principles of Mr. Scott Russell, the builder of the vessel. Her structure is that called the longitudinal system, which adds great strength to a vessel in the longitudinal direction where she is most subject to strain. This system has been introduced by the builder in many previous vessels which have now stood the test of years, and among others in the *Great Eastern*, where it is carried out to the greatest extent. The advantage of this structure is shown in the *Cleopatra* by the fact, that, although driven by powerful engines at great speed, the vessel seems hardly to feel the strain of the engine.

The engine of the *Cleopatra* is of an entirely new construction, known as Mr. Scott Russell's patent three-cylinder engine. It has been long known that three cylinders would give the most uniform and effective development of the power of steam: but the complexity that would result from the employment of three several engines, with all their crank shafts and appendages, has hitherto prevented their general adoption. In this case all complexity has been removed, and three cylinders are applied through a single crank, so as to occupy smaller space, and have fewer working parts than usually go to form the ordinary pair of engines.

The practical result is, that the uniformity of the action is manifest. The rapidity of the strokes is unusual; the steam is worked with great economy of fuel, and the ship attains high velocity with small consumption of coal.

The small engine, of 150 horses nominal power, works up to 900 horses actual power, and with a consumption of less than $2\frac{1}{2}$ lbs. of fuel per horse power; and the absence of the usual vibration is remarkable, considering especially that the hull of the vessel is unusually light, so as to have a small draft of water. Although the vessel is a strong sea-going ship, and contains engines developing so large a power, the draft of the ship, when ready for sea, is not more than 5 ft. 4 in.

The ship is commanded by Captain Johnston, an Englishman, of great experience as a sailor, who has superintended her equipment, and takes her to Constantinople. The cabins are beautifully fitted, and are decorated and furnished with the well-known taste of Mr. Crace, of Wigmore Street.

His Highness may be congratulated on having added to his fleet the fastest and handsomest vessel of her class.

At some future time we propose to give the practical details of the ship, and her engines, boilers, and machinery.

HOW MONEY IS MADE.

We have been asked by more than one correspondent to furnish them with a brief description of the process of making money practised in the British Mint, and in complying with this request we propose to give but a sketch thereof, and refer such of our readers as desire further information to "Ure's Dictionary of Arts, &c."

There appears to exist a considerable amount of misconception as to the manner in which money is made—not in the Barnum sense, but literally. Many persons imagine, for instance, that coins are, as it were, soldered together in two halves, and that the head is struck at one press, and the tail at another; but this is quite a mistake, the impressions being given to a plain disc of metal, or "blank," and the edge "milling" at a single blow. Ingots of gold or silver are first thrown into melting-pots and reduced to fluidity. After this they are cast into bars of various sizes, proportionate to the kind of coins to be produced from them. These bars are next passed forward to rolling-mills of great power (we speak here of the English Mint), and laminated, or drawn out by pressure to a state of attenuity marvellously different to the rigid form in which they left the moulds. The bars, in fact, are now converted into ribands, flexible as the wand of Harlequin; and these, being beautifully adjusted in thickness for the pieces to be obtained from them, are passed to a set of punching-presses, where they are perforated—honey-combed—from end to end. The discs of metal thus obtained are blank sovereigns, very much resembling shankless brass buttons; or blank sixpences, as it may happen to be sovereign or sixpenny "ribands" which are being dealt with; and are then carried forward to the weighing machines. These select the sheep from the goats—the light and heavy from the medium, or standard, blanks. The accepted candidates for coinage are now taken to the marking-room, whilst the rejected are doomed to the purgatory of the crucible again. The marking machines raise partially the protecting edges of the future coins, which are then again submitted to a fiery ordeal in the shape of an annealing oven. This operation softens and tempers them. They are made—as young ladies are said to be—susceptible to impressions, and are then pickled, or blanched, in a weak solution of sulphuric acid. This gives them a bright surface, and removes all impurities. Drying is the next process, and this is performed over a hot iron plate—*à la* muffin and crumpet. The blanks are now ready to receive the "image and superscription" of the Queen—God bless her! This finishing touch is given in the press-room. The pieces are now weighed out to a number of boys, who attend and feed the presses with them. On one side of the presses blanks are put into tubes, and on the other they are thrown out coins. They get, however, a mighty hard squeeze in the "middle passage," between two beautifully-engraved head and reverse dies, and are at the same time prevented expanding unduly by means of a collar of steel, fluted or milled on its *inner* circumference, which encompasses each individual piece at the moment the dies strike it. The *outer* circumference of the piece of gold or silver becomes thus serrated, or milled, at the instant of coinage. The finished sovereigns or sixpences, or whatsoever coins may be in process of manipulation, now tumble out from the presses in rapid and glistening succession, and slide down inclined planes into trays placed to catch them. They are examined on the surfaces and edges to ascertain if they are perfect, and then sent out into the "wide, wide world" to do their missions of good or evil, as the good or evil dispositions of their possessors may determine.

Such is a hasty and very familiar description of money-making; and if any of our young friends, for whom it is intended, do not feel quite satisfied with it, but wish to judge of the art for themselves, why, there is little doubt that Professor Graham, F.R.S., who is Master of the Mint (and a most worthy master too), would, in answer to a polite application made at this holiday season, give them permission to view the establishment on Tower-hill, and see some money made. This latter statement we venture upon without authority, be it known, but with much confidence, nevertheless. At any rate, we trust that none of our friends—young or old—may, in the *New Year*, or any year succeeding it, be destitute of specimens—yellow as well as white—of Mint workmanship—current coins of the realm.

BRITISH ASSOCIATION.—LEEDS MEETING, 1858.

DOUBLE CYLINDER EXPANSION MARINE ENGINES.

At the meeting of the British Association, at Leeds, the following was Mr. Elder's introduction to his description of drawings of double cylinder expansion engines, constructed by Messrs. Randolph, Elder, and Co., engineers, Glasgow:—

Before describing the plans of the double cylinder expansion marine engines, I may mention that these engines are constructed with the view of getting the greatest amount of power from a given quantity of steam at a given pressure, with less total weight of engines, boilers, and water, and occupying less total space than that occupied by the ordinary class of steam engines on board of steam ships; and, consequently, these engines are expected to have the following properties, if the above objects are successfully obtained, it being understood that the boilers have the usual efficiency:—1. That with these engines a steam-ship can steam the greatest distance possible with a given quantity of coals. 2. That a given distance can be performed in the shortest time, on account of the small weight of coals necessary to be carried. 3. That the greatest amount of cargo and passenger accommodation is obtained, from the small room occupied by the boilers and coals. 4. That where a given capacity of cargo and passenger accommodation is required, a smaller and, consequently, less expensive ship is necessary. 5. The boilers being less than the usual proportion, are less expensive to replace when required. 6. The number of firemen and stokers is reduced, and, consequently, the space occupied by them can be otherwise engaged, and their wages saved To accomplish these objects, the construction of these engines have followed the course we now describe. The cylinder capacity is so great as to admit of the steam being expanded to within two pounds of the pressure in the condenser, at the end of the stroke, while the engines are working full power. In order to reduce the violent shock of high-pressure steam on such a large piston, a cylinder with a piston one-third the size is placed close to it. This small cylinder receives the steam direct from the boiler during one-third of its stroke, and then cut off; this steam is consequently reduced to one-third of its original pressure at the end of its stroke, and then enters the second cylinder, where it is expanded three times more,—thus 36 lbs. steam is expanded to 4 lbs., viz., from 36 to 12 in the first. It then enters the second at 12, and is expanded to 4 lbs.; but as the second piston is three times the size of the first, the load will be the same on both pistons, and the piston-rods, cross-heads, and connection-rods may be duplicates of each other. The steam and eduction slide-valves are wrought with eccentrics. The steam valve is a gridiron with large lap; the eduction-valve, which serves for both cylinders, has no lap, and the eduction-ports remain open during the entire stroke of the piston, thereby giving a free egress for the steam, and ample escape for water should it form. In reversing the engines, the eccentrics are made to overrun the shaft till they arrive at the backing catch—a plan which is less likely to cause accident than the ordinary methods. The cylinders are steam-jacketed completely, and then covered with felt and wood. There is a small engine pump for forcing the distilled fresh water from the jackets into the boilers, or to the fresh water tanks if necessary. The boilers we are now making for such engines are tubular, with three large superheating uptakes, 2 ft. diameter and 15 ft. high, leading up through an oval steam-chest to the funnel; this makes a strong form of takeup, where it joins the tube-plate, especially in boilers firing across the ship. The feed-pipe of the boilers has twelve spiral convolutions inside the funnel, to heat the feed water—this may be shut off when desirable. Then, again, as to the economy: several may certify that this kind of engine has been thoroughly tested and found successful. The first was of 160 H.P.; has been working for four years with a consumption of about two-thirds the usual quantity of coal, and the expense of repairs during the first eighteen months was somewhat under £100.—The second and third pairs of such engines were supplied to the Pacific Steam Navigation Company, for carrying Her Majesty's mails from Panama to Valparaiso. That company appointed, along with the engineer, neutral parties to test and report on the performance of the larger vessel, *Valparaiso*, compared with another steamer, the *Pride of Erin*, the two steamers having the same kind of flue boilers, and the machinery of the *Pride of Erin* being of the first class of the ordinary kind, and in first-rate order. These parties, one of whom, Mr. M'Naught, of Manchester, certified that during the run from Glasgow to Liverpool the consumption was 2·98 lbs. per indicated H.P. per hour for the *Valparaiso*, while the *Pride of Erin*, during a five and a half hours' run, consumed 4·27 lbs. per H.P. per hour; in both cases the surface blows were open, and other circumstances duly considered; and the following is an extract from a report of Mr. Daniel Kinear Clark, C.E., on the same trial, in which he concludes:—"In brief, while the engines of the *Pride of Erin* exert only 4·25 indicated H.P. per square foot of fire grate, the engines of the *Valparaiso* exert 6·22, or nearly one-half more actual duty from the same fire, owing to the superior efficiency of the engines of the *Valparaiso*. If the *Pride of Erin* were to be fitted with engines of the same class as those of the *Valparaiso*, her indicated power would be 1,340, instead of 917, with the same boilers. It is determined, therefore, that the engines of the *Valparaiso* consume about a third less coal to do the same work, or will do a half more work with the same coals as ordinary engines." I may also mention that the *Valparaiso* has been found to maintain her character on the west coast of South America. She has been there now two years. She consumes on the voyage from Panama to Valparaiso and back 640 tons, while the other ships consume 1,150, carrying the same cargo, passengers, &c., in the same time and in the same circumstances. And, as further evidence, I may mention that they are bringing home, 9,000 miles, two steam-ships, with first-class ordinary machinery, of modern construction, to have that machinery replaced with engines the same as the *Valparaiso*, but with such improvements as the engineers may be pleased to give. These improvements will be—the partial superheated steam, the hot feed, and the complete steam-jackets, which in the *Valparaiso* were only in the bottom of the large cylinders, and all the cylinder covers which are hollow. I may also add that this company have now about ready for trial another new steam-ship, of the same model, same engines—with the improvements referred to—as the *Valparaiso*; and if any member of this Association could be present at the trial trip, the contractors would be happy to see them, in order that they might examine for themselves. I may also add that the ships above referred to as coming home to be refitted will return with 30 ft. length of space gained amidships for passengers and cargo, in consequence of the saving of room by reducing the necessity of boiler and coal space, and that the vessels are expected to consume 500 tons less on the voyage, which, at £4 per ton, is £2,000; and the ship will have 20 per cent. more accommodation, which in itself should be valuable. For further evidence I could refer to any other of the ships, among them to the steam-ship *Admiral*, lately constructed by James Napier, Esq., for a Russian company. This ship was tested by Professor Rankine, and found to consume exactly the same as the *Valparaiso*, namely, 2·98 lbs. per indicated H.P. per hour. Since the arrival of that ship at her destination there have been repeated letters received, showing a remarkably small consumption of coal compared with the work done. The last accounts were, that she had 450 tons dead weight on board, going about $11\frac{1}{2}$ knots, with a consumption of $19\frac{1}{2}$ cwt. per hour.

INSTITUTION OF CIVIL ENGINEERS.

November 23, 1858.

Joseph Locke, Esq., M.P., President, in the Chair.

The Paper read was On the Successful Working, by Locomotive Power, over Gradients of 1 in 17, and Curves of 300 feet radius, on Inclines in America, by Mr. T. S. Isaac.

It was stated, that the road which had decidedly taken the lead in the United States, in the application of Locomotive Power to steep gradients, and had been generally the pioneer of improvements, was that extending from Baltimore, on the Chesapeake Bay, to Wheeling on the Ohio River, a distance of 380 miles, through a region of considerable difficulties, especially in the various ranges of the Alleghany Mountains. This Company was incorporated in 1827, being the first chartered in America, and a portion of the road was opened in May, 1830. At first it was worked by horses, but locomotives were employed as early as August, 1830, prior to the opening of the Liverpool and Manchester Railway. Legislative and financial difficulties prevented the commencement of the western section until the year 1849, and it was not until 1851, or three years previous to the opening of the Sömmering incline, that the great incline over the main range of the Alleghanics was completed, and worked by locomotives. This latter had an inclination of 1 in $45\frac{1}{2}$ for 11 continuous miles, and after winding amongst the summits of the mountains for 20 miles, it descended, on the western side, with an inclination of 1 in $45\frac{1}{2}$ for 9 continuous miles. The passage of this mountain chain involved altogether 60 miles of railway, 20 miles of which had a gradient of 1 in $45\frac{1}{2}$, and 9 miles of 1 in 50, both worked by locomotive power, at a speed of from 15 to 20 miles per hour for passenger trains, and from 10 to 15 miles per hour for goods trains. The curves were frequently 600 ft. radius. Although it was one of the main thoroughfares of American commerce, no extra provision was made for working these inclines, beyond increasing the number of the engines. The engines had 8 wheels, all coupled, the diameter of the cylinders being 17 in., the length of the stroke 2 ft., and the diameter of the wheels $4\frac{1}{2}$ ft. The engines weighed 24 tons each, and the tenders 13 tons each.

In 1852, difficulties were encountered at two different tunnels, which rendered temporary inclines necessary, in order to accomplish the passage of the trains. This system was frequently adopted, when it was required to surmount hills, where the tunnels were incomplete, in order to enable the iron and other materials for the permanent way to be delivered along the line. There was a maximum gradient, over the Kingwood tunnel, of 1 in 10, and this incline was in operation for several months, the iron and other materials for upwards of 40 miles of line, and the United States Mails, having been conveyed over it, by locomotive power. The same engine that was used on the other parts of the line was employed, and it drew a loaded car weighing 13 tons, and a tender weighing 12 tons, or a total weight of 25 tons, at the speed of 8 to 10 miles per hour. Over the Board Tree tunnel there was a series of zigzag inclines, on which the upward motion of the train was alternately reversed, the engine at one time pulling, and at another pushing, the cars. There were three of these inclines on the eastern, and five on the western slope of the hill. The total length was nearly two miles and one-third, and the gradients varied from 1 in 18 to 1 in 15½, with a minimum radius of curvature of 300 ft. The ordinary freight consisted of two loaded cars, weighing, together with the tender, 37 tons. Mr. Latrobe, the chief engineer of the line, said in his report for 1853, that as many as fifty cars, containing 400 tons, and two passenger trains, had been taken over this hill in a day by four first class locomotives, and that during five months there had been no accident involving more than a trifling detention. These two inclines, although unprovided with engines especially adapted for the purpose, fully demonstrated the feasibility of traversing gradients, altogether unprecedented, by the locomotive alone. The experience gained in working them not only established the fact that a rise of 300 ft. per mile, and curves of 300 ft. radius, could be worked with comparative facility, but seemed to point also to a limiting gradient, beyond which it was impossible for the locomotive to go, with any useful effect, even for a temporary purpose.

Steep gradients and sharp curves had since been adopted on the Virginia Central railroad, on a more extended scale, and had been in successful operation for upwards of four years. The Mountain Top incline on this road crossed the Blue Ridge Mountains, at Rock Fish Gap, in Virginia. It was 4 miles and one-third long, with a ruling gradient of 1 in 18·87. But on the lower half mile of the eastern slope, the gradient was 1 in 17·86, on curves of 570 ft. radius and upwards, and the minimum gradient, on curves of 300 ft. radius, was 1 in 22·22. The length of the eastern slope was 2·37 miles, with an average gradient of 1 in 20½; and of the western slope 1·89 mile, with an average gradient of 1 in 22·22. The whole distance worked by the mountain engines was 8 miles, over which the average gradient was 1 in 29½. The engines were mounted on six wheels, all coupled, and set close, the outer wheels being only 9 ft. 4 in. apart from centre to centre. The diameter of the cylinders was 16½ in., the length of the stroke was 20 in., and the diameter of the driving wheels was 3½ ft. A tank was provided over the boiler, capable of holding 100 cubic ft. of water, and above this there was placed 100 cubic ft. of fuel; an additional quantity being stored under the foot-board, which was lengthened for the purpose. When supplied with wood and water sufficient for a trip of 8 miles, each engine weighed about 24½ tons. The usual weight of a mountain train was 45½ tons, the speed being limited, by regulation, to a maximum of 8 miles per hour. The consumption of fuel was three-quarters of a cord of wood westward, and half a cord eastward. Greater loads had been conveyed, but those given were the results of ordinary working. For accomplishing the descent, all the cars were provided with a break to each wheel, of sufficient strength to lock the wheel, if necessary, and a breaksman was stationed at each end of the car. The breaks of two cars were found sufficient in ordinary weather; but when the ground was covered with snow, or ice, recourse was had to the air cocks of the engines, and sand was applied to the breaks. The author considered that a judicious combination of these two methods was preferable to the exclusive use of either. There was nothing in the motion of the train itself, except a diminution of the speed, to indicate that such steep gradients or sharp curves were being traversed. It had now been in operation for upwards of four years, without a single accident.

The author believed that the resistance of the curves had been underrated in America. On the Mountain Top incline it was proved that the resistance of the curve exceeded 25½ lbs. per ton of engine and train. Mr. Latrobe had calculated that the resistance to traction, on a level, was doubled by a curve of 400 ft. radius, and he assumed 13 lbs. per ton as the additional friction of a train, on a curve of 300 ft. radius, whence the additional friction of the engine due to such a curve must have exceeded 49 lbs. per ton of its own weight. Two expedients had been resorted to for diminishing this friction. On the Baltimore and Ohio incline, for a speed of 10 miles per hour, the outer rail had been gradually raised, on a curve of 300 ft. radius, from 2 in., the height given by the ordinary formula, to 9 in. On the Mountain Top track inclines, for a speed of 8 miles per hour, the outer rail had an elevation of 6½ in.; and a sponge, saturated with oil, was kept in contact with the flanges of the two forward wheels of each engine. These expedients had so far reduced the friction on the latter road, as to cause no perceptible diminution of speed on leaving a straight portion of the track, with a gradient of 296 ft. per mile, and entering a curve of a radius of 300 ft. having a gradient of 238 ft. per mile.

The Virginia Central Company had also constructed a shorter incline, about 100 miles further west, which was 1½ miles in length, with gradiants varying from 250 ft. to 300 ft. per mile, and curves of a minimum radius of 400 ft. Over this incline, which had been in successful operation for two years, the common freight engines, on eight wheels, four of which were coupled, giving 16 tons for adhesion, had taken a load of 36 tons, at a speed of 5 miles per hour.

The ordinary performances of the engines on the Mountain Top Track showed an exertion of 181½ H.P., including the engine in the load, or 118 H.P. not including the engine; giving, in the latter case, 4·8 H.P. per ton of motor, the resistance due to the speed and the gradient being 121·64 pounds per ton.

On one or two occasions, on the incline of 1 in 10, on the Baltimore and Ohio line, the weight of the engine being four and three-quarter times the resistance of gravity and the friction of the load, when the rails were very greasy, the engine and train slid backwards with locked wheels, from near the top to the bottom of this incline, without damage. The wheels of these engines had chilled tyres; a circumstance which considerably decreased their adhesion. The engines on the Mountain Top Track, with an ordinary train, exercised an adhesive power of one-sixth of their weight, and this could always be maintained, in the severest weather, by the use of a fine clean sand.

In conclusion the author remarked that, there were probably few mountain passes that could not be overcome by the introduction of gradients of 1 in 17, and experience had satisfactorily proved, that the locomotive could draw a load nearly double its own weight up such a gradient, at a speed of 8 miles per hour. The working of the Mountain Top Track furnished addditional evidence to that already gained from other sources, of the superiority of light engines with light loads, over heavy engines with heavy loads.

HALL'S APPARATUS FOR WORKING RAILWAY BREAKS.

After the meeting a model was exhibited of an apparatus, by which railway carriages were coupled together, so as to render the action of the breaks continuous throughout the train, and thus render it possible to apply three or four breaks simultaneously. A longitudinal square bar was suspended under each carriage, the connection being made by a universal joint coupling. In making up a train, the break blocks of the break vans were screwed up close to the rims of the wheels, and then the coupling was effected, so as to avoid the possibility of slack. The break blocks were so arranged on the carriages that two operated in each direction, so that the carriages might be moved either backwards or forwards, indiscriminately; but this was not the case with those attached to the tenders and the break van. The mode of applying the power was similar to that ordinarily in use. There was a worm-wheel on the spindle of the handle from the van, working into a cog-wheel, fast on the longitudinal shaft. On this shaft there was also a screw working in a loose collar, to which was attached the ends of one pair of levers, operating the arm of a lever, on a fixed shaft, also carrying the levers to which the blocks were attached.

November 30th, 1858.

George P. Bidder, Esq., Vice-President, in the Chair.

The whole of the evening was occupied by the discussion of Mr. Isaac's Paper On Steep Inclines in America.

It was explained that on the Baltimore and Ohio Railway, the ordinary goods engines had cylinders of 19 in. diameter, with a stroke of 22 in.; they had 8 driving wheels, of 3 ft. 7 in. diameter, all coupled. The passenger engines principally employed on the inclines of 1 in 45½, had cylinders of 19 in. diameter, and 22 in. stroke, with 6 driving wheels. 4 ft. 2 in. diameter, all coupled, and a leading truck, or bogie, on 4 wheels. Peculiar arrangements were made for facilitating the passage over curves of small radius; the centres of the front and hind wheels were only 11 ft. 3 in. apart, and the intermediate wheels were without any flanches, the springs being so adjusted as to equalise the weight.

It was stated, that the adhesion of driving-wheels had been shown, from experience in the United States, to be beyond the limits usually assigned. Instances were known, where the effective adhesion had been as much as two-fifths of the nominal weight on the driving-wheels; it being assumed that this varied much when running, as compared with the actual weight ascertained by the weighing machine when at rest.

On the Cleveland and Pittsburgh Railway, on the 1st August, 1857, a train of fifty loaded waggons, each on eight wheels, and weighing, with the engine and tender, 800 tons, was drawn up a continuous incline, 2 miles in length of 1 in 132. The engine weighed 26·8 tons, with only 19·2 tons on the six coupled wheels. The gravity of the entire train would be 13,575 lbs., whilst the friction, which could not average less than 5 lbs. per ton, would increase the amount to 17,575 lbs., or to more than two-fifths of the weight upon the driving-wheels.

In making a series of trials for the New York and Erie Railway, Mr. Zerah Colburn drove a train of 80 waggons, each on eight wheels, weighing, with the engine and tender, 1,270 tons, up a continuous incline of 1 in 480, with curves of 1,145 ft. radius. The gravity being 6,000 lbs., and the other resistances 8,300 lbs., the entire resistance was 14,300 lbs. The weight on the driving-wheels of the engine, at rest, was 40,500 lbs.; hence the adhesion was 0·35 of the insistent weight.

An engine, when on a severe incline, changed its position so much as to alter materially its running position, which should be provided for in building engines expressly for working inclines.

It was stated that, at the time of construction of the Mountain Top Incline, it was found necessary to place a tank on the eastern slope, on a gradient of 1 in 18·87. During the first two or three summers, the ascending trains were in the habit of stopping daily, and the engines were able to start again without difficulty. There was one engine on the mountain on eight wheels, all coupled; the cylinders were 18 in. in diameter with a length of stroke of 22 inches; the wheels were 3½ ft. in diameter, and the gross weight of the engine was 27 tons. This engine had crossed the mountain six times in one day, with a load of 49 tons each time; making the trip in one hour from Turntable to Greenwood, and in one hour and a quarter from Greenwood to Turntable; although it was very rigid and was not adapted to the curves. One of the lighter engines had taken a load from Turntable to Greenwood in half an hour. Mr. Ellet had published a statement of the cost of working, based on the fuel and oil consumed, and the wages of the workmen. Fuel on the mountain cost two dollars per cord. It was difficult to make a just comparison of the various fuels, and to obtain correct information as to the water evaporated. The same cause that prevented the experiments on the resistance of curves, prevented comparative experiments on fuels, and accurate statements of the water evaporated. At first pine was used, but oak had been extensively adopted latterly. The effective pressure of the steam, above that of the atmosphere, usually amounted to from 100 lbs. to 120 lbs.

It was remarked, that whereas, on most English railways, the results of experience showed a resistance of 12 lbs. per ton gross on a level, yet some of the statements which had been made, as to the working of railways in the United States, seemed to indicate a resistance of not more than 5 lbs. per ton gross, after allowing for gravitation on the incline; whilst the permanent way of American lines was notoriously inferior in all respects to that of the English lines. The first of the results named in the Paper showed a traction resistance of about 150 lbs. per ton gross. In contrast with this, it was stated, that on the Great North of Scotland Railway, near Aberdeen, the Kitty Brewster Incline of 1 in 59, and full of quick curves, had been worked, for the last three years, by two tank locomotives, having cylinders 15 in. diameter, with a length of stroke of 24 in., and four wheels coupled, each $4\frac{1}{2}$ ft. diameter, at a steam pressure of 150 lbs.; the load on the driving wheels being 15 tons, on the leading wheels 10 tons, and the gross weight, in working order, 25 tons. The trains were started from the foot of the incline. One of these engines could take up nineteen waggons, weighing, when loaded, about 11 tons each—making a total gross weight of train, behind the engine, of 200 tons—at 10 miles per hour. The greatest load that had been taken was twenty-one waggons, of a gross weight of 230 tons, at 5 miles per hour. The average ordinary train taken up the incline consisted of eighteen waggons, each weighing 8 to 11 tons gross; the total weight being, say, 160 tons gross, at 10 miles per hour; but excursion trains of loaded carriages, weighing, when empty, $5\frac{1}{2}$ tons each, and $7\frac{1}{2}$ tons when loaded, making a gross load of, say 200 tons, had also been taken up. The resistance of the train, indicated on the piston, after allowing for gravitation on the incline, amounted to 13 lbs. per ton gross, of engine, tender, and trains, which contrasted favourably with the estimated traction resistance of 150 lbs. per ton gross, on the American incline.

With reference to the influence of curves upon resistance, it had been found that, at a speed of 45 miles per hour, the traction resistance was greater, by 20 per cent., on a line having curves under one mile radius, at the rate of one curve in $2\frac{1}{2}$ miles, than on a practically straight line.

It was remarked, that the Whitstable branch of the South Eastern Railway, on which there was a gradient of 1 in 30, had originally been worked by stationary engines and rope traction; but as the traffic was intermittent, it had been determined, some years ago, to substitute locomotive power, and this application had been quite successful. Bury's four-wheel coupled engines, having cylinders 14 in. in diameter, with a length of stroke of 24 in., the wheels being 4 ft. 6 in. in diameter, were still in use on this branch. Four trucks of coal were taken up the incline of 1 in 30, the gross weight, including the engine and tender, being about 50 tons.

On the Folkestone Branch of the same line, which had an inclination of 1 in 30, for upwards of three-quarters of a mile, four-wheel tank engines, constructed on Mr. Crampton's plan, were employed. The four wheels of $4\frac{1}{2}$ ft. diameter were all coupled; the cylinders were 16 in. diameter, with a length of stroke of 24 in.; the weight of the engine was $26\frac{1}{2}$ tons, and the pressure of the steam was 120 lbs. per square inch. These engines had taken up the incline a load of fourteen carriages, equal to a gross weight of 100 tons, including the engine.

It was believed that the peculiar construction of the engines and carriages, in the United States, tended to lessen the resistance of curves. It was well known that in New York, and in other American cities, the railways were brought into the streets, horse power being then employed, and that the trains were conducted round the turnings of streets with great facility. As to the cost of construction of American railways, it appeared from official returns, which had been carefully compiled, that in the State of Massachusets the cost of the principal lines had amounted to £10,599 per mile, or £9,489 per mile, exclusive of rolling stock. In the State of New York these figures were respectively £11,200 and £9,762 per mile. It should be stated that a large proportion of the American railways consisted of single way, and that their cost ranged between £5,000 and £14,000 per mile.

The Manchester, Sheffield, and Lincolnshire Railway, with a gradient of 1 in 130 for upwards of 22 miles, was mentioned as a case of a main trunk line, upon which there was a large traffic, necessitating the employment of heavy engines. Ordinary inside-cylinder engines were employed, the cylinders being 18 in. in diameter, with a length of stroke of 24 in., the wheels being 5 ft. in diameter, all coupled. They weighed, when in working order, 31 tons, were worked at a pressure of 130 lbs. to the square inch, and would draw a load of 40 waggons, weighing 130 tons, independent of the weight of the engine and tender.

The great feature in the Paper under discussion was thought to consist in the statement, that two-fifths of the weight of the engine had been obtained as adhesive capability; whereas, in this country, one-fourth had been considered as much as could be relied on, in all states of the rails. On the West Cornwall Railway, loads of about 13 tons had been conveyed up an incline of 1 in 13 for a distance of from a half to three-quarters of a mile. The engine had four wheels coupled, and cylinders 13 in. in diameter. This plan had been considered preferable to the employment of stationary power. On the South Devon line there were gradients varying from 1 in 41 to 1 in 51, with S curves of 15 chains radius. As a practical fact it might be recorded, that the engines would take seven loaded waggons up an incline of 1 in 41 on straight portions of the line, but when they came to curves of 15 chains radius, one of the waggons had to be removed.

It was stated, that on the Lickey Incline of 1 in $37\frac{1}{2}$, an engine had been allowed to attain a speed of 30 miles in descending, and it was then brought up in 30 seconds by the application of a peculiar kind of break to the wheels of the engines.

With regard to zigzag inclines for traversing mountains, it was stated that the late Mr. George Stephenson had suggested their adoption, 13 years ago, on a line in Spain. Mr. Drane had also recommended that this method of crossing high mountains should be adopted in Ceylon. And more recently, as was well known, Mr. I. J. Berkley, M. Inst. C.E., had carried out the system successfully, on the Great Indian Peninsular Railway, for ascending the Bhore Ghaut. It was thought, that they were only desirable under special circumstances, and in peculiar positions, where it was impossible to make a continuous line, except at great cost, or by the introduction of excessively sharp curves.

Probably, the steepest gradients in this country, over which a large traffic was conveyed, were on the line between Manchester and Oldham, a distance of 7 miles. For a mile and a quarter there was an inclination of 1 in 48 or 1 in 50. The line was then tolerably level, until, on approaching Oldham, gradients of 1 in 30 and 1 in 39 were encountered; and for about a mile and a quarter 1 in 27. This latter incline had originally been worked by stationary power and rope traction; but about five years back, the locomotive had been substituted, and no difficulty was found in taking up considerable loads.

In closing the discussion, the circumstances under which steep inclines could with propriety be adopted, were considered, and it was remarked that, as a mechanical question, there was no difficulty in apportioning the power of the engine to the amount of adhesion required to traverse a particular gradient. But inclines of 1 in 10 or 1 in 17, or even 1 in 40, would only be resorted to from necessity, as such gradients were attended with a heavy cost for working expenses On a branch of the Stockton and Darlington railway, where there was an exceptional gradient of 1 in 40; although the traffic was all down-hill, the whole of the receipts of that portion of the line, taken at 1d. per ton per mile, were absorbed by the working expenses. If the loads had been uphill, it was believed that the working expenses alone would have amounted to 3d. per ton per mile, and with gradients of 1 in 17, it was thought that this must reach 1s. to 1s. 6d. per ton per mile. In fact, it was questionable, under such circumstances,, whether horse-power and carts would not beat the locomotive, in point of economy; though of course on a long line of railway, it would be most undesirable to introduce a break of gauge. It was undoubtedly more economical to employ locomotive power on the Whitstable Branch, where the amount of traffic was so inconsiderable; on the the Oldham Incline, the necessity of preserving an unbroken communication was a justification for the use of the locomotive, the cost of which in such a case must be considerable. On the incline of 1 in 26 near Liege, a perfect system of stationary engines had been in use for many years. The Belgian Government, feeling the inconvenience of that system, had abandoned it, and substituted the locomotive; but such was the uncertainty of the power, in meeting the inequalities of the incline, that the stationary engines had been again resorted to.

December 7, 1858.

Joseph Locke, Esq., M.P., President, in the Chair.

The Paper read was, A Description of a Breakwater at the Port of Blyth, and of certain Improvements in Breakwaters, applicable to Harbours of Refuge, by Mr. M. Scott, M. Inst. C.E.

This communication was divided into four parts, the first referring particularly to the breakwater at the Port of Blyth, the second to the theory of waves, the third to the theory of hydraulic construction, including form and methods of building, and the fourth relating exclusively to the Author's designs, including his assumed improvements in the construction of breakwaters, which had been suggested by his experience in connection with the work at Blyth.

The Port of Blyth was described as being situated on the coast of Northumberland, about 10 miles north of the river Tyne. The whole surrounding district was rich in coal, comprising a large virgin field of steam coal in the immediate vicinity. Until recently a small class of vessels only could trade there, and a great part of the coal raised in the neighbourhood was transmitted by rail to the Tyne for shipment. But a few years ago a company was formed, and powers were obtained for improving the harbour, Mr. J. Abernethy, M. Inst. C.E., being appointed engineer in chief, and the Author undertaking the construction of a portion of the works. This part of the coast was exposed to a very heavy sea, and gales sprung up with great suddenness. For the length of a mile the river was exposed to the action of the sea, so that no vessel could then lie in what was now the harbour. Along the seaward side of the river there was a rocky reef, and upon the base thus provided by nature the breakwater had been erected. The work was originally intended to be, and for a length of 1,800 ft. was constructed entirely of stone; but a failure in the supply of material induced a change. Mr. Abernethy proposed to employ timber and stone, after the manner adopted at Boulogne and at Calais. These views had been carried out in a part of the breakwater which had been completed for some time, which consisted of a framework of timber filled with stone, arranged thus:—First, there was a sole-piece resting on the ground. Under each end of the sole there was placed a block of stone, to which it was fastened at one end by a bolt, the chief object of this bolt being to act as a guide in erecting the frames. Upon this sole were raised two uprights, the one next the sea being supported by a strut from the sole-piece. Cross-bearers, or half balks, embracing the uprights, carried the roadway above, which was protected by a simple handrail. The frames thus formed were placed at intervals of 10 ft. from centre to centre, and were tied together, longitudinally, by walings—two on the sea face, and one on the river face, and also by the open planking; the space within which was filled with rubble stone. In the first section this space was triangular, the planking on the river face being on the strut. The object of this arrangement was partly to provide a sloping surface, and to leave the uprights on the river face isolated, opposite the entrance of the proposed docks, for the purpose of destroying, as much as possible, the swell which passed up the river. In the second section, the exposure and consequent strength required being greater, the planking was put upon the river upright, and the whole space between was filled with rubble, covered with an open flooring of horizontal timbers. The work had added more than 4,000 ft. in length of the river to the harbour, where there was still water; it not only effectually broke the waves, but acted as a training wall to direct the current, and to confine and intensify, within the new limits, the action of the tidal scour. The cost of the work had been, on an average, about £10 per lineal foot. The site of this pier was either dry, or nearly so, at low-water spring tides; but as it was to be continued into a depth of 5 or 6 ft. at the lowest ebbs, and about 22 ft. at high water of spring tides, it was necessary to modify the plan, and as early as January, 1857, the Author succeeded in the application of timber to deep-water sections, in the manner hereafter described.

Under the head "Theory of Waves," the Author availed himself of the labours of Messrs. Scott Russell, Airy, Robertson, and others. He called attention to the two kinds of waves—the one long, low, but extending deep, which was the Wave of Translation, or wave of the first order; the other kind short, high, and superficial, being the Wave of Oscillation, or wave of the second order—and laid down certain principles belonging to each class. He concluded this section by remarking, that if a wave in deep water, when the mass was great, and the velocity of the particles small, travelled into shallow water, the quantity agitated was less, but the energy of the motion was increased. Therefore, *cæteris paribus*, the destructive energy was less, against a wall vertical from the bottom, than against a wall built with a slope. When the foreshore caused a wave to break upon the wall, the destructive effect was greatest. Waves would be broken by any slope having an inclination of less than 45°, but from that angle to the perpendicular, the wave would not be broken, unless it was nearly upon the point of breaking when it reached the slope.

In the third part, under the head "Theory of Work," including the Theories of Form and of Construction, the published views of General Sir Harry Jones, Sir William Denison, Professor Airy, Captain Vetch, &c., were freely made use of; and it was remarked, that when waves could be reflected, they ought not to be broken, and that when, from shallowness of the water, the wave must break, the operation should be spread over the largest surface, and over the longest time possible. It was desirable, if practicable, so to direct the water, that the force of one portion should tend to neutralise the destructive energy of another portion; it being better to effect the object of stilling the water, by changing the direction, than by absorbing the force of the water in motion. The first condition would be fulfilled by a vertical wall, and the second by a slope. The third was more difficult of attainment. Under the term vertical wall might be included steep slopes, say from 60° upwards. It was thought, that as the vertical face in deep water did reflect waves, the seaward face of breakwaters, especially near the entrance to a harbour, should be built nearly vertical; for should it be a slope, the risk to a vessel approaching the entrance would be increased. With regard to the inner, or harbour side of a breakwater, it was obvious, that a vertical face was the best; inasmuch as the work then constituted a valuable quay, alongside which ships might lie, to load and unload passengers, cargo, or stores, whereas, in the case of a slope, no vessel could approach. With regard to slopes, the Author considered the true principle to be, that they should be employed only for the purpose of directing, or guiding the waves, to neutralise one another. This he sought to effect, at least to some extent, thus: first, the slope formed of timber was not to join the ground at the foot; there was to be no toe to be injured, but a space through which the water would freely pass. Secondly, the surface of the slope, instead of being continuous, was to have horizontal open spaces, like a gridiron, through which part of the water would fall in its passage upwards, and part on its recession.

The combination of the vertical wall and slope, as carried out at Alderney, at Holyhead, and at Portland, was then alluded to; and it was believed that as, even during a very heavy sea, there was but little agitation at a depth of 15 ft. under the surface, this section would present nearly, if not all, the advantages of a vertical wall, carried up from the bottom of the sea. The quantity of stone used in these works was, however, very great, so that there were many situations where that method of construction would be inapplicable. There were other disadvantages attaching to this form. First, these breakwaters were not available as quays. Secondly, the seaward profile was such, that the waves must break upon the wall with all their violence, and hence the weight of material, and the nature of the work, necessary to resist such a shock, were no criterion of that required in a vertical face, from which the waves were reflected, and against which they did not break.

The subject was next investigated under the head "Theory of Construction—Stone Work," and it was urged, that the faces of works exposed to the sea should either have the joints sealed, to prevent the entrance of air, or the work should be so open as to allow the air to pass out with facility. Continuity of face was most important in breakwaters, particularly with vertical faces, for without this, the strength of the work, as a whole, would be dependent upon, and be measured by, the power of resistance of the weakest part. Hence arose the necessity of exercising great care during the construction, as the displacement of a single stone might lead to the destruction of the whole work. The Author knew of no case on record of a breakwater being carried away, or being overturned, bodily; and therefore the question was not so much the strength as a whole, which could readily be calculated, but the action of the sea upon an individual portion, which could not be calculated. And if this obtained as regarded the finished work, for the same reasons the danger during the process of construction must be great, especially in the case of a vertical wall.

The fourth section of the paper was occupied with a description of the Author's improvements in the construction of breakwaters. He divided these works into two classes; those intended for deep water being wave reflectors, and those for shallow water being wave breakers. Excepting what was called the wave screen, the reflectors and breakwaters were of a similar character, consisting of a timber casing, filled with stone. The stone hearting constituted the power to resist removal as a whole, and the timber facing secured the stone from being disintegrated, or carried away in detail; so that if the work was moved, it must be bodily. Further, the work was so connected together, that each part supported its neighbouring portions; and there was no tie between the work and the ground. It simply rested on the surface, and the stability depended wholly upon its weight. Other leading features of this arrangemen were then noticed, and it was stated that the lower tie would accommodate itself so perfectly to an uneven surface, that the erection might proceed on sand and clay as well as on rock; on broken as well as on even ground, almost indifferently. The manner in which the round ends, at the entrances to harbours, were constructed, was then described, and it was shown that the planking was arranged like basketwork, by which both strength and elasticity were obtained. It was said that the work was not liable to be breached during erection, and that this had been proved at Blyth, where the stone wall had been repeatedly damaged; but the new construction had remained uninjured, although exposed to heavier seas. The frames were put together complete on shore, and were then floated to their place, and it was remarked that the 9 or 10 lbs. of oil per cubic foot, used in preserving the timber, materially reduced the floating power; so that it was found, by calculation, for a depth of 10 fathoms, supposing the whole of the timber to be immersed, the total buoyancy would only be 15 cwt. per foot run; but as the timber was not wholly immersed, there was no buoyancy. At half tide, when standing on end, each frame would have a weight, or downward pressure, equal to 8 cwt. to sink it. The timberwork, when finished, would have a downward pressure of 25 cwt. per foot run. Thus, it appeared that the weight to be lifted was but little, and that the frame in position could easily be made to gravitate sufficiently to steady itself until secured In the direction of the length of the breakwater, the frames were kept parallel by sliding ties, which were simply balks of timber, with chocks between them, embracing two frames, and being secured together above water, they were slid down to the bottom. Various other details were then given of the mode of carrying on the work under this arrangement, and it was remarked, that the systems pursued at Dover, Alderney, Portland, and Holyhead, did not appear to secure rapid execution, whilst, in illustration of what could be done by this plan, although of course on a comparatively small scale, it was mentioned that of the work at Blyth, 130 lineal feet had been erected in five days.

With regard to the power of the work to resist waves, it was stated that, in the section for a depth of 10 fathoms, the stability was double the greatest force which could be brought to bear upon it. To afford protection to the footings of a wall, or to the toe of a slope of stone, in the recoil of breaking waves, a screen had been designed, the construction of which was explained.

In reference to the questions of durability and cost, the Author was of opinion that properly prepared timber would last twenty years, and that the section for a depth of 10 fathoms would cost, completed, about £70 per lineal ft.; whereas the stone breakwater at Alderney was said to have cost £190 per ft., and that at Portland £150 per ft. This difference in first cost was so great as to leave, it was considered, an ample margin for the renewal of the timber when it decayed. The manner in which this renewal might be effected was then described.

Finally, it was shown, that even if the new arrangements were regarded merely as a means for forming the back-bone, as it were, of a more permanent structure, it was the best and cheapest way of attaining the object desired; for viewing the timber only in the light of a temporary staging, the following were some of the advantages claimed for the system—rapidity of execution; a good staging from which to build the stone facing; and the rubble hearting, having been exposed to the sea for years, would be thoroughly consolidated, and form an impenetrable backing.

The Author then proceeded to describe the method proposed for completing one form of the permanent work. There were some peculiarities in the mode of setting the face blocks, the objects in view being mainly two; first, for affording increased facilities for handling heavy masses; and secondly, to place within easy reach of the divers the means of moving the stone in every direction, without the necessity of communicating with any one above water. This was effected by a system of hydraulic and other machinery, which was then described in detail, for moving masses weighing 25 tons each, in six different directions, either down, up, forwards, backwards, to the right, or to the left.

In commencing the discussion, some extracts were given from the Report of the Select Committee on Harbours of Refuge; the tenor of these observations was, that of the three modes of construction of piers brought before the Committee, that of tipping the material as "pierre perdue" was that most generally employed, and had hitherto proved most successful. From these passages it appeared that the general opinion was not favourable to the building of nearly upright walls for piers projected into the sea. It was, however, contended, from the experience of some years, at the Harbour of Refuge works, at Dover, that by the use of improved machinery, and by the employment of helmet divers, instead of men in diving-bells, large blockwork could be accomplished almost as easily, and nearly as quickly, as above the waterline.

The machinery for the proposed modification of the present system was described to be—having a powerful stage consisting of trestles, as at Dover, or by substituting for timber cast or wrought iron tubular uprights, with the upper extremities made to slide, in order to level the stage in case of the subsidence of the feet. Trussed beams supported the rails for the travellers carrying the steam boiler and engine, with the air-pumps for supplying the divers, and for lifting and laying the blocks; to which it was proposed to give very much increased dimensions,—such as 15 ft. long by 10 ft. wide, and 6 ft. 8 in. deep, which, if made of brick and cement, would weigh about 50 tons; it was contended that two thousand of these blocks could be laid during each year, and an advance forward of 900 ft. per annum of a pier whose total sectional area was 3,082 superficial ft.; and this with brick and cement blocks at a cost of about £180 per ft. lineal; if of rubble stone blocks and cement, about £110; and if of concrete, about £101.

If smaller blocks were used, the plant and machinery might be reduced in bulk and cost, and even still greater progress might be made. An instance of this was given by allusion to the pier, now being constructed in Rye Bay, of concrete blocks weighing 10 tons each: up to the present time it had perfectly resisted storms from the south west, to which it was much exposed.

The further consideration of this subject was then adjourned until the evening of Tuesday, January 11th, 1858; when, it was hoped, the Members and Visitors would come prepared to discuss this interesting question.

After the Meeting, Mr. C. Defrics exhibited and explained some specimens of his Improved Railway Carriage Roof Lamps.

Three objects were sought to be accomplished in these lamps. First, by admitting cold air into the burner; thus, preventing the oil from boiling, the overflowing of the oil iu the glass, so common in other lamps, was prevented. Secondly, a simple method of fixing the glass was adopted, so that by having a stock of glasses at different stations, a broken onc might easily be replaced: instead of, as at present, it being necessary to send the damaged lamp to the repairing shops, in order that a new glass might be soldered in. Thus a much smaller stock of lamps would be required, and less expense would be incurred for repairs; in addition to which the chance of breakage, in the transit from the stores, would be entirely removed. Thirdly, the interior of each lamp was made in one piece, instead of three or four pieces, as customary. This tended to increase the light, which was remarkably clear and brilliant.

ON THE MODIFICATIONS WHICH THE SHIPS OF THE ROYAL NAVY HAVE UNDERGONE DURING THE PRESENT CENTURY IN RESPECT OF DIMENSIONS, FORMS, MEANS OF PROPULSION, AND POWERS OF ATTACK AND DEFENCE.

Extracts from a Paper read, December 15, at the Society of Arts by E. J. Reed.

The science of naval architecture was so greatly advanced on the Continent, and so much neglected in England, during the last century, that the forms, dimensions, and speeds of the ships of the British navy were for the most part inferior, class for class, to those of every other nation with which they had to cope.

The only mode of improvement which the naval authorities of that period countenanced was that of imitating the forms of such captured vessels as were deemed superior to our own, and therefore, as "imitation cannot go above its model," the attainment of excellence was not possible. Full advantage was not taken even of the imitative system, imperfect as it was; for, whenever the form of a foreign model of any given class was copied, the dimensions, and therefore the power of carrying weight and sail, were invariably reduced, aud many of the best qualities of the vessel thus sacrificed.

Throughout all the wars waged by England during the eighteenth century, with France, Spain, Holland, and America, the genius of our admirals had continually to struggle with the great evil of overburdened ships. Whenever a British man-of-war fell into the hands of the enemy, her armament was forthwith diminished, and her efficiency thus improved, as was frequently discovered on the recapture of our own ships. That inferiority no longer exists. The ships of our navy have not only ceased to be imitations, but have become the models for the navies of the world; and I have now to trace the progress of the great changes which they have undergone—changes which embrace not minor variations merely, but entire and unprecedented transformations, consequent mainly upon the introduction of steam.

When the conclusion of the wars with America and France, and the successful expedition to Algiers, had left us without notable enemies, leisure was afforded for the consideration of such improvements as experience had shown to be desirable. Sir Robert Seppings, the Surveyor of the Navy, and the introducer of several important improvements in the frames and other portions of the fabrics of ships of war, effected great changes in their bows and sterns. After the battle of Trafalgar, the *Victory* was repaired at Chatham Dockyard, of which Sir Robert was then master shipwright; and in surveying her he observed that she had suffered much on the upper or main deck, when bearing down on the enemy at the commencement of the action, in consequence of the grape-shot penetrating the thin transverse beak-head partition then in fashion, which was without the ordinary timbering. It was perfectly evident, he said, that had the ship been formed with a regular and solidly-built bow, many a life would have been saved. This was fully acknowledged by Captain Hardy; and after a short period the strong circular or curved bow now in use, which is framed and planked like the rest of the ship, was introduced. This bow is attended by additional advantages—including the use of bow guns, an increase of strength, and others which I cannot stay to mention.

Sir Robert next turned his attention to the sterns of vessels; and here he considered a similar change necessary, to improve the defence of the vessel, to increase her strength, and to enable her to fight her stern guns with greater advantage. It was objected by some opponents of Sir Robert that the evils he believed to exist were not real; that sterns were not weak; that their fighting capabilities did not need improvement; that we had no need of stern guns in our navy at all, as we always fought and never run; and that by improving our sterns we should only be teaching our enemies who did run how to arm theirs. The circular sterns were, however, undoubtedly attended by one great fault, which Sir Charles Napier pointed out:—"In the first place," he says, "the rudder is too much exposed. In the second place, the ship is deprived of her counter, which I have always considered a very necessary part of her, and which one would suppose the very derivation of the word from the French word *contre* sufficiently proves the utility of. I apprehend without that projection the sea would come in at the cabin windows; and lastly, the whole of the gingerbread outside of the ship would be blown away when the guns were much used." The first of these objections is, doubtless, perfectly valid, and the last not without reason. The second, however, is not well founded. It is not possible that the use of a certain word by the French can "prove" the utility of a ship's counter; it may indicate the opinion of the French upon the point, but it can do no more. Further, it is evident that the low projecting counter of a ship may receive shocks from waves which would never climb to the cabin windows.

The round stern was, however, attended by another defect, which, together with the exposure of the rudder, led to its abandonment, and to the adoption of its main features in a modified form. This defect was the heavy and ungraceful appearance which all agree in attributing to it. The attainment of beauty is not certainly the primary object in the construction of vessels of war. On the contrary, if there were on earth any object in which an utter want of beauty might be deemed tolerable, it would be, I presume, a ship of war. But beauty is never unbecoming; we look for it even in a war-ship, and the elliptical stern which has succeeded the circular stern, eminently possesses it. The design of this stern, which permitted the builder to afford increased protection to the stern-post, and which is now adopted in all new ships of war, was claimed by each of three late master shipwrights—Mr. Lang, Mr. Blake, and Mr. Roberts. It was introduced under the auspices of Sir W. Symonds, and in the form which is now given to it by Sir Baldwin Walker, the present surveyor of the Navy, is a truly admirable combination of beauty and utility. The principal curves visible in it harmonize so well with the sheer lines of the ship, that she appears to float lightly and easily upon the water, whereas the circular Seppings' stern, with its obtrusive stern-post, made the spectator feel not only that much of the ship was submerged, as it in fact was, but also that the submersion of the whole of her was imminent.

It was intended that with the improved bows and sterns, the foreward and the right aft guns might be fired in the direction of the keel—that is, be brought to bear upon an enemy immediately in front or rear of the ship, and that the fires of every two adjacent guns from bow to stern might cross each other within easy range, so that the ship should have the power of defending herself, and of attacking an enemy in every direction with two guns, at least. Great difficulty was, however, often experienced in getting the bow chase guns to run out far enough to prevent injury to the ship on the discharge of the gun; for it is by no means an easy matter to make a vessel sufficiently bluff for that purpose on the deck line, and at the same time to keep her fine at the load water line. This difficulty has recently been evaded by the adoption of a pivot gun raised above the fixed bow of the vessel, and capable of being turned upon shifting centres at one end, and of running on circular or segmental plates at the other. This gun commands the entire sweep of the bow, and, being usually of large calibre and long range, is admirably adapted for chasing. Its introduction into the service was a very notable improvement. The pivot gun is usually a 68-pounder, sometimes a 10 in. shell gun, and it is fitted in all our first-rate steam line-of-battle ships, aud most other steam ships of war, including second and third rates, frigates, corvettes, and many scores of our steam gun boats. In several classes of ships a second pivot gun, of like size, is fitted at the stern. All our steam block ships are thus fitted, as are also the whole of our screw steam gun vessels, numbering, according to the current number of the "Navy List," twenty-six. It is difficult to believe, however, that we are acting wisely in accepting the bow pivot gun as a sufficient substitute for the bow chase guns on the fighting decks of our screw line-of-battle ships, as I observe we have done in some modern examples. The pivot gun is an exposed gun, and is liable to be disabled in action; it cannot therefore be prudent to depend, in a large ship, upon it alone for our power in chasiug, and to deprive ourselves of the means of firing a single shot directly in advance, should that one gun be injured. I am fully aware that by runniug this risk fine lines may be given to the vessel, but this advantage is not worth the risk, as I fear we shall prove in the event of a naval war if we pursue the new system.

Still more interesting changes were introduced by the successor of Sir Robert Seppings.

The characteristic features of Sir William Symonds' designs for ships were great breadth of beam at and above the water line, and great sharpness of floor. Sir William was essentially an amateur ship-builder, and the Lords of the Admiralty (influenced mainly by Sir James Graham), by investing him with supreme control of the Surveyor of the Navy's department, made war not only upon professional naval architects, but upon the profession of naval architecture itself. The consequence was that ship-building officers, both of the old tentative school and of the new scientific school (which latter had lately been called into existence by their lordships), strenuously resisted Sir William's innovations; but as he was supported by powerful friends, and had a large amount of patronage in his own hands, while his oppouents were almost without exception his subordinates, I need not say who for the time triumphed. It should be observed, however, that the principles of construction for which Messrs. Read, Chatfield, Creuze, and others trained in the school of naval architecture, contended, are to a great extent predominant at the present day in the Royal service, while not a single feature of Sir William Symonds' system of construction is retained,* except certain practical improvements which he made in the actual building of ships, and which deserve to be mentioned with the utmost favour. He was the first who proved successful in breaking down and abolishing

* As an example I may refer to the forms of midship section advocated respectively by him and by them. Sir William's great principle—or rather Sir William's great crotchet—was the sharpening the floor of the ship, at the same time carrying her greatest breadth considerably above the load-water line. The latter he deemed essential to stability. The members of the School of Naval Architecture, on the contrary, pointed out that, by making her sharp of floor, and broader above the water-line than at it, the ship, when inclined by the wind, by tending to immerse more of herself on one side than emerged on the other, would be moved bodily upwards, and thus subjected to vertical motions, more or less violent, which would tend to the injury of her fabric and the discomfort of her officers and men. They therefore recommended the midship portion of the side of the ship should be either vertical, or similarly inclined immediately above and below the water-line, and considered that nothing better than a side vertical between wind and water could be chosen for a ship of war. I have only to add, on this point, that all new ships of war now have the full floors and vertical sides which they recommended. Thus, on two points of the very first importance, Sir William's ideas have been discredited, and the same may be said with equal truth in respect to his third doctrine—that of the necessity of giving great depth of beam in proportion to length. The proportion is less now than ever. E. J. R.

that vicious system of restricting constructors to certain arbitrary dimensions, to which I have before referred, and in which the Admiralty persisted until his time. This was no small service.

Had Sir W. Symonds lived a century earlier, his career might have closed in brightness and triumph; but, coming when he came, he had scarcely raised himself to his high office before he began to feel his schemes and crotchets baffled by a power whose marvellous progress no devices of man can withstand. The all-changing irresistible power of steam, against the mastery of which so many have vainly mutinied, began to make itself felt in the Royal Navy even before Sir William commenced experimenting at Malta. In 1815, Lord Melville ordered an engine to be built for the sloop of war *Congo*, and, although that vessel was not fitted with it, the design of propelling ships of war by steam was not abandoned. In 1821, the *Monkey*—a vessel which is still, I believe, doing duty at Woolwich—was purchased by the Admiralty, and her name is likely to become memorable as that of the first steamer the Royal Navy possessed. Her purchase was followed by the building of the *Comet* at Deptford dockyard, under the direction of the late Oliver Lang, Esq. Other vessels succeeded rapidly, some designed by Sir Robert Seppings, others by the master shipwrights of the dockyards, and others by private builders. All were, of course, for many years fitted with paddle wheels. Ultimately, in the year 1832, Sir William Symonds had the designing of steam, as well as all other vessels for H. M. Serviee, committed to him as Surveyor of the Navy.

In the year 1837, Captain Ericsson made a very favourable run down the Thames in a steam vessel fitted with his patent screw propeller, having the Lords of the Admiralty and Sir W. Symonds on board. Notwithstanding the success of the experiment, and the manifest advantages of a submerged propeller for a ship of war, Sir William made no sign in favour of the new instrument. Captain Ericsson, therefore, took it to the United States, where it was specdily introduced into the war navy of America. Three years afterwards, in 1840, the *Archimedes*, fitted with Mr. Smith's patent screw propeller, made many highly successful trial trips, which were reported to the Admiralty by officers of their own. After further opposition and a further delay of years, the *Rattler*, a ship of war, was adapted at Sheerness to receive a screw propeller, and after numerous experiments with screws of different forms, the two-bladed screw now exhibited at the Patent Museum, South Kensington, was finally adopted as the best that could be devised. In 1845, the *Rattler* was tested in comparison with the *Alecto*, a paddle-wheel vessel of similar form, size, and steam-power, and the test still further established the superiority of the screw. The *Rattler* was by chance built with a particularly fine run aft; but as this was not known to be essential, other screw steamers were commenced with a greater fullness near the stern. The access of the water to the propeller would thus have been seriously interfered with, but Mr. Lloyd, now the chief engineer and inspector of machinery in the steam branch of the Surveyor of the Navy's office, very wisely foresaw the evil, and induced the Admiralty to take the necessary steps for its prevention. Since 1846, the building of screw ships has become so general, that not only has the paddle-wheel been altogether superseded in all newly-built fighting vessels, but there is not even a single ship unprovided with a screw now on the stocks. Every ship now built is fitted with that steam-driven submerged propeller, the introduction of which the late Surveyor of our Navy only eleven years since was obstinately resisting, and had obstinately resisted for eleven years previously.

Admiral Sir Charles Napier, to whom I have had occasion already to make reference, was among the very first to apply iron as a material for constructing steam-vessels. With Sir Charles Napier was associated Mr. Charles Manby. Together these gentlemen formed a society, and built the first iron steam-vessel, the *Aaron Manby*, which Sir Charles took charge of, and navigated to Paris. Other vessels followed; but for their history I must refer you to Mr. Grantham's admirable volume on "Iron Shipbuilding," in which their progress is traced from the earliest example up to that magnificent vessel to which the London public are now thronging, and which, by her excellence of design and her strength of structure, even more than by her immense magnitude, excites the astonishment and admiration of all intelligent beholders.

In 1842 Mr. Belmano, of New York, addressed a letter to the Earl of Aberdeen, alleging that plates of iron three-eighths of an inch thick had been riveted together to a thickness of six inches, and then found to be ball-proof. Sir Thomas Hastings, of H.M. gunnery ship *Excellent*, was instructed to discover if they were so. After making the experiment, he reported that such a combination of plates fixed over the planking of a ship's side would give no protection at two hundred yards against shot fired with 10 lbs. charges of powder from 8-inch guns and heavy 32-pounders.

In 1843, however, the Admiralty commenced building iron ships of war, and in three years built and purchased eighteen such vessels (besides several others not intended to carry armament), at a eost of £420,000 and £260,000 additional for engines—in all about £680,000. I can offer no reason for this sudden and unexpected movement, which has, I hardly need say, ended in failure. It may have been the result of a well-meant but ill-advised attempt to give a rapid expansion to the power of the Royal Navy, or it may have been due to the secret influences brought to bear on some member or members of the Board of Admiralty by interested parties. But of that ingenious and complicated system of wheels within wheels by which our public departments are often worked, I cannot presume to speak. Like millions of others, I know but little save of that one great wheel, the outermost of all, which rolls perpetually along the land, whose revolutions never cease, and from whose path but few escape—the colossal and ponderous wheel of national taxation. Of the wheels within, which move *that*, who has any just or adequate knowledge?

In the construction of mercantile vessels iron is superior to wood. Iron ships, as compared with wooden, may be built lighter and stronger, of greater capacity, of superior speed, increased durability, and at a less cost both for purchase and repairs. In Great Britain, moreover, iron is much more abundant than wood, and its manufacture is now becoming improved almost daily. On the other hand, the bottoms of iron ships get rapidly foul, and their hulls, when of moderate thickness, are shattered by the action of shot much more injuriously than the hulls of wooden ships. The first objection is got rid of in merchant vessels, by cleaning their bottoms when they come into port. The second is, of course, not directly applicable to them. But the rapid fouling of the bottom of a vessel of war, which is often engaged for years together far from all facilities for cleaning her below water, would, at all times, be a highly injurious and often a fatal evil. The destruetive action of shot upon such a vessel is a still more decided ground of inefficiency. These facts were not considered by the Admiralty in 1843, and when Sir Charles Napier mentioned in the House of Commons the folly of building five or six iron steamers without trying one, the Secretary of the Admiralty exultingly exclaimed, Sir Charles informs us, "We are building forty." They did build, not forty, but eighteen, at a cost, as I have said, of considerably more than half a million.

Experiments were made at Woolwich Arsenal to test whether, if iron were lined with kamptulicon—a mixture of India-rubber, cork, &c.—the holes formed in the fabric by the shot would not be stopped after the shot's passage, by the closing up of the elastic substance. Some advantage was gained in this way, but not sufficient to lead to the adoption of sueh a eombination. In 1846, the *Ruby*, a small vessel, built of thin iron, and in a bad state of repair, was fired at from the *Excellent*, and Captain (now Admiral) Chads, reported that the shot passed clean through the near side of the vessel, but that on the off side the effect was terrific, tearing off the sheets of iron to a very considerable extent. Splinters from the near side were few but severe. These conditions were reversed by subsequent experiments made by Admiral Chads, the near side being found to suffer most in stronger vessels. In July, 1850, after numerous experiments, he finally reported that iron could not be beneficially employed as a material for the construction of vessels of war. Since that time the building of iron ships of war has not been proceeded with.

I come now to the period of the late war with Russia, which, though a military rather than a naval contest, did not fail to exert important influences upon the constitution of the Royal Navy. That war opened, it will be remembered, by a Russian attack on a Turkish squadron at Sinope, November 20th, 1853, at a time when Russia had bound itself by a solemn promise to act on the defensive only. The Turkish squadron consisted of 7 frigates, 1 sloop, 2 corvettes, 2 steamers, and 2 transports, supported by five land batteries. The attacking squadron was composed of 6 line-of-battle ships and 2 frigates, supported by three or four steamers. The latter squadron was well supplied with shell guns, while the Turks had nothing more effective than 24-pounders. The action was speedily decided by the burning of almost the whole of the Turkish vessels, produced, as the surviving officers stated, exclusively by the shells of the enemy. The only frigate that remained afloat after the action—the *Damietta*—had seventeen shots through her below water, and was therefore burnt. I mention this engagement merely as an early and notable example of the destructive effect of shell guns in naval warfare, the remarkable circumstance being, not that the Turks were beaten—for the Russian force was vastly superior to theirs—but that their whole force of fourteen ships was, to a great extent, silenced in a few minutes, and utterly crushed in little more than an hour.

It has been fashionable in some quarters to sneer at the operations of the combined navies of England and France in the Black and the Baltic Seas during the war; but the spectacle of one Russian fleet sunk by Russian hands at Sebastopol, aud of another trembling, season after season, behind stone fortresses in the shallow waters of Cronstadt, never daring to accept the challenge of any British squadron, however small, is one the record of which we certainly may read without shame. Still, the fleets of England, though well adapted for battles by sea, and sufficient to drive the enemy from the open waters, were almost totally deficient of the class of vessels which were essential to the putting forth of our full power against his fleets and coasts. Nor was the want supplied with anything like that promptitude which the occasion demanded. It is difficult, with all the facts before us, to believe that the neglect occurred in the naval department. The Government, it will be recollected, was inactive; slow not only in entering upon war—which all governments should be—but slow also in conducting the war after it was entered upon—which no government should be. When they grew vigilant and active, and the Naval Department was called upon to provide light-draught steam vessels without delay, the work was entered upon with astonishing and admirable rapidity. All the capabilities of the royal dockyards were put into instant requisition; the Government steam factories were everywhere expanded, and in some places, such as Sheerness, created; and private builders were called upon to take up large contracts. The execution of these contracts, though performed with the utmost alacrity and good-will, involved the contractors in serious pecuniary losses, which the Surveyor of the Navy exerted himself to mitigate, and did mitigate to some extent. This evil was, I grieve to say, greatly aggravated, if not altogether oeeasioned, by the excessive demands for wages made upon the contractors by their workmen, who knew they were needed, and straightway played the tyrant.

Mr. Scott Russell's paddle-wheel gun vessels, the *Recruit* aud *Weser* (formerly the *Nix* and *Salamander*), are in many respects most excellent vessels, and the former proved very valuable in the Sea of Azof. Captain Dahlgren, of the American navy, mentions her as "highly spoken of, being a fast and an excellent sea-boat." But the same experienced officer says also of the Admiralty's vessels—"For the service contemplated, this fleet of small screw-vessels was well adapted, far better than any other." Further, Sir Howard Douglas, Bart., the distinguished author of "Naval Gunuery," to whom the naval service is more indebted than to any other man, living or dead, for the efficient use of its armaments, published only a fortnight since a treatise on "Naval Warfare," in which, while he complains of the great length of the despatch vessels as a cause of weakness, he adds, "A smaller class of steam-vessels has since been eonstructed as gun-boats, and these come fully up to the author's idea of what a good gun-boat should be." They possess, however, one great defect in the rapidity with which the tube-plates of their boilers burn out. So great is this evil in the gun-boats, that in the mere trials of the engines, the boilers often become so bad as to require extensive repairs.*

The Admiralty have frequently been accused of building line-of-battle ships in profusion, to the neglect of frigates and lighter vessels. If there was some show of reason in this charge at the commencement of the Russian war, since that period there has existed no ground for its repetition. Our navy is now composed of the following fighting vessels:—First, 201 sailing vessels of all classes, but few of which, probably, will ever be again commissioned. Next, we have 75 paddle-wheel steamers, most of which, though not very effective for fighting purposes, will, while they last, be of considerable value in times of peace, and of some service even in war. Finally, we have a fleet of screw steam-ships and vessels, to the constitution of which I desire to draw particular attention. It consists of 51 line-of-battle ships, each armed with 8-inch shell guns and 32-pounder solid shot guns, in various proportions, together with one, and in some cases two, pivot 68-pounders; 9 block ships, also armed with 8-inch shell guns, and 32-pounders in various proportions, together with two 68-pounders and four 10-inch shell guns to each ship; 28 frigates, most of them powerfully and some of them very formidably armed —the engines of 16 of the 28 being at least of 600 nominal horse-power; 13 corvettes, each carrying twenty 8-inch shell guns, and at least one 68-pounder, or one 10-inch shell gun; 8 other corvettes, armed with 32-pounders, and at least one pivot-gun each; 4 mortar frigates, with 13-inch mortars, 68-pounders, and 32-pounders; 8 floating batteries, entirely with 68-pounders; 27 sloops, mainly with 32-pounders; 26 gun-vessels, with 68-pounders and 32-pounders; and 163 gun-boats, each with one 68-pounder and one 32-pounder—in all 331, inclusive of a few now building and undergoing alterations. It is impossible to examine these figures without observing that the number of our frigates, corvettes, sloops, and still smaller vessels, is very large as compared with our ships of the line; and it is, in my judgment, equally impossible to point out any very glaring defects in the principle upon which they are armed.

I by no means wish to imply that the armaments of our steam fleets are not susceptible of improvement with the means already at our disposal. The very variety observable in the armaments of ships of similar dimensions indicates imperfection, and even evinces a sense of imperfection in the minds of the authorities who arrange them. Moreover, Sir Howard Douglas and Captain Dahlgren have particularised one class of gun which is much used by us, but which is too light for its duty, viz., the 10-inch shell-gun of 86 cwt. This gun has been superseded in the American navy by one of 107 cwt., and should certainly occupy a less prominent position in ours.

Before passing to topics of a novel character, it should be stated, however summarily, that, in respect to those great features to which I refer, viz., dimensions, forms, means of propulsion, and powers of attack and defence, the ships of our navy have become, during the surveyorship of Sir Baldwin Walker, the embodiments of all such sound and well-tested improvements as have been hitherto found compatible with the purposes for which ships of war are designed. I may state, first, that the dimensions of our ships are increased, as necessity seems to require without any kind of prejudice. We have 50-gun frigates of nearly one-fourth greater tonnage than the largest line-of-battle ships of fifty years ago. Then the tonnage averaged in large ships about 25 tons per gun; now it averages in our frigates 50 tons per gun. It is true that this difference partly arises from the introduction of the engines and fuel, but it is also greatly due to a wise increase in the carrying power of the ship, independent of her steaming requisites. Again, the forms of our present ships have been adapted, by the introduction of fine water-lines, to the circumstances attendant on screw propulsion, so as to ensure the high speeds for which our navy has lately become remarkable. Sir Howard Douglas, in his treatise on "Naval Warfare," refers this quality partially "to the adoption of the *wave principle* in forming the bows." This, however, is a mistaken though a very pardonable supposition. Mr. Scott Russell's wave-line theory, which, whether right in all or in some only of its features, has been the occasion of vast improvements in ship construction, is not, I believe, adopted by the Admiralty. Many of their ships have, it is true, some water-lines which are hollow; but this has arisen not from any admiration for hollow water-lines as such, but from the necessity of combining a convex bow above the load-water-line with fineness and straightness of form at that line, which cannot well be done without giving a slight degree of concavity to the bow below. The extent to which the present surveyor has adopted the screw propeller has already been mentioned; and it may be here added that most of the engines fitted to the steam-ships of our navy are among the finest specimens of marine engineering. The remarks I have already made on the armaments, and those I have presently to make on the armour defences of our modern war-ships, will be seen, on the whole, to give completeness to that favourable opinion which I am here expressing. All this does not, of course, imply the absence of minor defects, but it does indicate that the present surveyor of the navy, with the able and well-trained scientific assistants, has not been slow to adopt changes when associated with improvement.

I have now to consider the exceptional vessels denominated floating batteries. The first I shall mention is the *Spanker*, which was designed about the year 1800, by Mr. Richard White, and of which Mr. Fincham, in his "History of Naval Architecture," gives the following account:—"This vessel was intended to be a formidable floating battery, to carry guns of large calibre and mortars, so as to be suited for offensive operations in bombardment as well as for the defence of harbours. She was on the deck, 114 ft. 6 in.; 42 ft. 4 in. in breadth. The main deck was of an oblong shape, and square across at the bow and stern, so that four guns might be fired in lines parallel to the keel. This deck was made to project beyond the bottom, and was intended to be sufficiently high above the water that when boats should go alongside to board, they might be drawn under the projection in which scuttles were formed to fire through into them; but the ship had not enough displacement, and the projection was therefore brought too near the water for the boats to go beneath it. Under sail this vessel was unmanageable; hence she was soon kept for harbour service alone, at Sheerness."

No floating battery was again undertaken in England until the late war with Russia, when the Emperor Napoleon commenced the building of several of these vessels, propelled by steam, and protected over their whole assailable surface with thick armour plates of iron. The original conception of iron-plated vessels has been generally attributed to the Emperor; but he was by no means the first proposer of them. In the second volume of the "Mechanics' Magazine," published in 1824, was an article in which notice was taken of a memoir written by a M. de Montgery, a Captain in the French Navy, in the following terms:—"M. de Montgery contends, that while we have vessels of war constructed of wood, they should, at least, be plated with iron. Long before any one had thought of substituting metal for wood in the construction of large vessels, plates of iron or brass had been used for covering ships of war and battering rams. The celebrated galley built by Archytus and Archimedes, for Hicro, tyrant of Syracuse, was cased in this way. Philo of Byzantium afterwards proposed using battering machines made entirely of metal; but Father Mersenne appears to have been the first who thought of adopting them for ships. M. Montgery says, that to render the sides of a vessel shot and shell proof, they should have a plating of iron about six inches thick; that is, a series of sheets of iron with blocks of cast iron between." The proposal to use plates of iron on the sides of ships was likewise made many years ago by General Paixhans, in his "Nouvelle Force Maritime."

The Emperor Napoleon having undertaken the construction of such vessels, and the English press having become apprised of the fact, a similar undertaking was, to a certain extent, forced upon the Admiralty; and the eight remarkable structures which now exist in our harbours are the result. It cannot be denied that these vessels were prematurely built, or that they are in many respects inefficient as ships of war. In the fourth edition of his "Naval Gunnery," published in 1855, Sir Howard Douglas stated several very cogent facts bearing upon the construction of these craft. To one passage in particular I would refer: "Nor will iron slabs 4½ inches thick," he said, "be proof against 68-pounder or 84-pounder solid shot, with which it appears the Russians are plentifully provided; and unless the timbers of these vessels are enormously thick, such heavy shots will not only punch holes in the iron, but may also make great breaches in their sides by their prodigious power." In confirmation of these observations, I may state that some of the worst effects stated to have been produced by the late gun practice at Portsmouth upon the *Meteor* and *Erebus* floating batteries, were consequent upon the yielding of the timbers, or of the ribs, rather than upon the penetrability of the plates. I cannot speak with absolute certainty upon this point, because, as the experiments were of great public interest, the Lords of the Admiralty were most careful to have the shot holes covered over with canvas as soon as they were made. I have since applied to their lordships for copies of the reports made upon the trials; but their lordships were unable to comply with my request.

The floating batteries built by the Admiralty are undeserving of that utter condemnation which some have pronounced against them. Sir Charles Napier, for instance, committed a great error when, in a letter to the *Times*, he mentioned, "Iron floating batteries which could hardly swim, and if they could would have been useless; for, had they been placed within 400 yards of Sveaborg, they would have been annihilated, and at 800 yards they would have done no harm." Those batteries are armed, as before stated, with 68-pounders, and Sir Thomas Hastings' experiments on the *Prince George* hulk, twenty years ago, proved that, at 1,200 yards, 68-pounders are highly destructive, and we all know that they are so at even much greater ranges. The true defects of the batteries lie, not in any weakness of armament, but in their slowness of speed, their unmanageableness at sea, and, as the late experiments appear to show, the weakness of their frames.

It is time that all those who concern themselves with this great question of how iron may best be rendered available for the defence of ships' sides, should recur to the circumstance which gave rise to it, and to the true end to be at present attained. That circumstance undoubtedly was the introduction of Paixhans shells into naval warfare; and the end desired is the application of means by which the entrance of those terrible missiles through the side of a ship may be avoided. The attainment of this end would leave us subject only to the entrance of solid shot, to which all our ships were exposed during the wars in which we won our supremacy, and from which no practicable system of iron plating can at present be expected to save us. The attempt to build ships which shall be proof to solid shot—at least, to wrought-iron solid shot—is an altogether illusory one; and such ships are not urgently required. It is as a defence against shells, and hollow charged projectiles generally, and against these only, that iron plating can yet be made available. By applying iron of very great thickness between wind and water, we may reduce the liability to injury by shot at that important part, and it may be well to do

* I have great pleasure in being able to state that Rear-Admiral J. Jervis Tucker, and Mr. Blaxland, Superintendent Engineer of the factory at Sheerness Dockyard, have energetically endeavoured to remedy this evil, and have succeeded in getting rid of the troublesome and expensive tubular system altogether. They simply employ a series of several fire-clay bridges, within the furnace, in conjunction with means for admitting air, at the same time diminishing the size and increasing the number of the fire-places. The system answers perfectly, and not only does away with the derangements and expenses attendant upon the tubular system, but also increases the evaporation, prevents the formation of smoke, greatly economises the fuel (a very important point in marine boilers), and renders the supply of steam to the engine surprisingly uniform. Some delay has occurred in the adoption of these improvements by the Steam Department of the Admiralty, mainly, I believe, in consequence of Captain Halsted and the engineers of the steam reserve at Sheerness having instituted experiments with a modified form of tubular boiler, which appears to me to be either the same as, or a very slight variation of, the boiler patented by Mr. Bartholomew in 1855. It is difficult to believe that there can be any partiality on the part of the Steam Department of the Admiralty to tubular boilers, the defects of which have been so fully explained by this Society's distinguished prizeman, Mr. Charles Wye Williams, and I am happy to hear that the Admiralty contemplate having a gun-boat or two fitted for trial with the improvements of Admiral Tucker and Mr. Blaxland.—E. J. R.

this; but if the upper works are made shell-proof we can expect no more. These considerations reduce the question to a form in which it may be practically dealt with, and I doubt not the solution of it is not very distant.

The only suggestion I have personally to offer upon the point is one in which I find I have, like many others, been altogether anticipated by the gentlemen at Whitehall, but which I may nevertheless mention. It will be evident that fifty feet in length of iron plating on the bow or stern of a vessel, while they would weigh the same as fifty feet of similar plating near midships, would cover and protect a much smaller volume of the ship. I would propose, therefore, that the midship portion of the ship only be protected, and that it be separated from the forward and aft portions by strong iron water-tight compartments, so that, however much the extremities might suffer, the ship would still be safe, and the men protected. Means would of course have to be provided for extinguishing any fires which might be, occasioned by shells in the undefended portions of the ship. This plan has been considered, I believe, but whether it is judged favourably or not I am unable to say—probably not, as it does not appear to afford any defence against raking shot.

Before quitting this branch of my subject I ought to add a word on Mr. Macintosh's system of warfare, which Lord Panmure for a time forcibly suppressed. It consists in surrounding fleets or fortresses by floating naphtha, firing the same with potassium or otherwise, and thus enveloping the enemy in a cloud of vapour, which either destroys him or drives him from his guns. This is not a mere theoretical proposition made without consideration, the inventor having chartered a vessel during the war, and proceeded to the Black Sea with a cargo of naphtha for the purpose of attacking Sebastopol. His amicable intentions were frustrated by indisposition of our admirals to adopt so great an improvement.

Having now hurriedly reviewed the modern changes which our ships of war have undergone, and glanced at those floating suggestions which some are so eager to urge upon the Government, it will be well to consider for a moment a few facts bearing upon the immediate future of our navy. And, first, there cannot be a doubt that the Government can, if they please, hasten the introduction of great and radical changes. It is perfectly within their power to build ships of war of a far more destructive character than those which this or any other nation now possesses. But would it be politic for us to take the lead in such innovations? A navy like that which we possess involves, it should be remembered, the investment of an immense amount of capital. The cost of a ship of war when rigged and equipped may be estimated at £35 per ton, exclusive of the cost of her armament, and the engines involve a further expense of, say, £60 per nominal H.P. We have in our navy at the present moment 607 fighting ships, of an aggregate burden of 665,220 tons, and carrying engines of scarcely less than 100,000 H.P. Therefore our ships alone have cost us nearly £22,000,000; and upon their engines we have made a further outlay of nearly £6,000,000. Consequently, we have invested in these ships nearly £28,000,000. Now, any radical change in the construction of war ships must tend to render this enormous sum of money lost to us, and entail upon us a fresh expense of like or of greater amount. No other power has so large and expensive a navy, and therefore no other nation has so much to lose by sweeping changes. As good economists, we should not then be over hasty in developing new means of naval warfare in times of peace.

The defence of our coasts is, of course, at all times a legitimate subject of improvement, and no necessary pains should be spared in rendering that complete; but that may be best done by manning a sufficient number of the ships we have, rather than by devising new ones; and the existing Government will deserve great praise if they provide the means of doing this. There is no sign of weakness now visible in the navy of England, save in its lack of men. The ships we possess carry no less than 15,140 guns, and could these be all discharged at once, would, at each round, project 254 tons of iron; in one day of twelve hours, firing but one round per minute, they would therefore project 914,000 tons, enough to form a solid cannon ball 120 feet in diameter. To fully man all these ships, and bring all their powers into play, we should require but 162,000 men, and if we had but a fair proportion of these to call upon in an emergency, our defence would surely be complete.

It will probably be objected by some, that the French and Americans are building a new class of formidable vessels, and that we must, therefore, do the same. But the assumption of such objectors requires proof. The "ram's nest," lately discovered in America, is very much like another kind of nest which some people are very often finding. The "ram" that it contains need occasion no alarm. It has already cost the American Government 800,000 dollars, and a committee appointed to examine it is said to have reported that it will take 8,000,000 more to complete the operations begun. It is, therefore, exceedingly likely to remain in its nest for very many years to come; indeed, an American scientific paper some time since pronounced it fit only for exhibition to visitors, at three cents. apiece, as a monument of folly. As to the French, they have, like ourselves, many inducements to refrain from great innovations. Where we have 60 steam line-of-battle ships, they have 30; where we have 330 steam ships, they have 220; and where we have 600 ships in all, they have 400. Further, much that we have heard of their proceedings is not only false, but ridiculous. The rumour that they were building six *polished steel* frigates, by which some persons were recently plunged in deep distress, was manifestly put forth to excite our foolish fears; and statements less evidently absurd are, doubtless, often started with a like object. The French navy itself, though too costly to be thrown lightly aside, is greatly inferior to ours, as we have just seen, and the Emperor can be doing nothing that our Government are not advised of, and which they are not, therefore, at liberty to do also, and doubtless would do were it anything formidable. Certainly nothing yet made public need excite our apprehension. Give us a strong Channel fleet, liberally manned and well disciplined, and no power that the French, or any other Government, possesses would dare to menace our coasts; nor would any man venture to say, with Sir Francis Head, that "nothing but the will of a foreign emperor kept London secure from a foreign army."

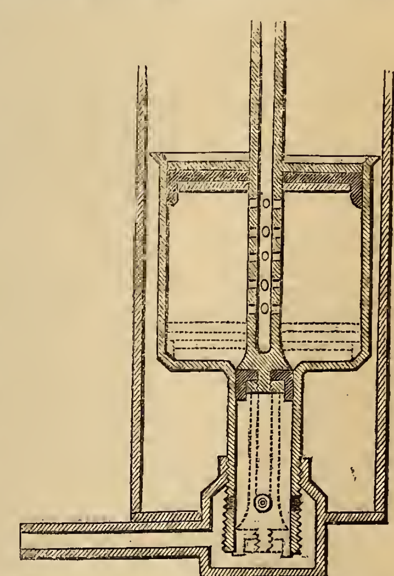
The paddle-wheel has made us independent of sails; the screw has made us independent of the paddle-wheel; and the 200 horse-power engine of the *Rattler* has been followed by the 1,000 horse-power engine which is to drive the *Mersey*, and that may speedily be replaced by one ten times its power. A single improvement in the manufacture of iron, which hundreds are now seeking daily to improve, may at any moment give us the means of carrying our steam pressure to unheard of heights,* of resisting shells with the utmost ease, and of augmenting the strength of our ordnance tenfold. By eagerly arming ourselves with all the warlike agencies with which science may thus supply us, regardless of all consequences, we may certainly make our navy most terrible; but we shall at the same time, by the very preponderance of our might, compel all other powers, secretly at least, to make common cause against us, and thus prepare the way for universal strife. On the other hand, if we content ourselves with vigilantly observing the changes which other powers make, and adopting only such improvements as are necessary to keep alive that wholesome respect which all nations now feel for us, we shall neither encourage ambitious powers by our weakness, nor alarm timid powers by our strength, but shall continue to stand, a solid and impregnable bulwark, in the shelter of which men may peacefully work out their highest and noblest destinies.

The progress of shipbuilding has been impeded by the state of financial matters in the mercantile world, and the falling off in the employment for shipping; but it is curious to observe, that whilst shipowners are complaining very loudly of want of employment for their present tonnage, that on the 18th November last there were building on the banks of the river Wear only, no less than 69 vessels of various dimensions, chiefly of 300 to 700 tons, and some few of over 1,000 tons measurement.

AMERICAN NOTES.

New York, Dec., 1858.—I send herewith a description of the Washington Hydrant, for which was awarded the silver medal of the American Institute in 1857:—

The Washington Hydrant.—This invention, which was patented by Messrs. Perrini and Boyles, in the United States, June 23rd, 1857, has, we are informed, been found to answer admirably. The accompanying sectional view represents the working part of the hydrant, which is composed of two cylinders, connected in the centre and open at each end, into which plungers, with cup-leathers, are fitted.



The small cylinder is screwed into a chamber, to which the supply-pipe is attached, the water surrounding the lower end of the cylinder, with holes to admit it. When the plungers are forced down till the small one passes the holes, the water flows into the small cylinder, thence through at the pipe, and out of the nozzle. When released, the pressure upon the small plunger forces it up past the openings, cutting off the supply, and continuing a sufficient distance, to allow the water in the pipe to descend into the large cylinder.

This hydrant has neither spring, valve, valve-seat, or cock of any description, and yet combines all the requirements of a hydrant, as it is self-closing and non-wasting; sufficiently protected from the cold to resist freezing, and is free from any shock or concussion of the water in operating it. By removing one bolt in the centre of the cap, all the working-parts are left free to be drawn out. Its constant use for two years authorises an opinion favourable to its general application.

I also send herewith the dimensions and particulars of the *Ocean Queen*, paddle steamer, built at the Morgan Works, New York:—

DIMENSIONS OF "OCEAN QUEEN."

Built by J. A. Westervelt and Sons, New York; Engines by Morgan Iron Co.

Length on deck	330 ft.
Breadth of beam	42
Depth of hold	22
Depth of hold to spar deck	30
Measurement of Hull / " Engine room	2,830 tons.

Kind of engine, vertical beam; ditto boilers, return flued; diameter of

* A simple but very important improvement in boiler plates, lately introduced by Messrs. Alton Fernie, of Derby, deserves mention in this connection. It consists in thickening the sides of plates, and bending the thickened parts to form the angles of boilers and other vessels, so that the ordinary plates may be riveted directly to the turned-down portion of the thickened plate without the use of angle iron. The full value of this invention it would not be easy to state. In addition to its direct advantages, it has the further one, doubtless, of getting rid of that unexplained but very common cause of failure of boiler plates, not at the joints, but in their neighbourhood.—E. J. R.

cylinder, 90 in.; length of stroke, 12 ft.; diameter of paddle-wheel over boards, 38 ft.; length of boards, 10 ft. 6 in.; depth of ditto, 2 ft.; number of ditto, 32; number of boilers, 3; length of ditto, 36 ft.; breadth of ditto, 14 ft.; height of ditto, exclusive of steam-chests, 11 ft. 3 in.; number of furnaces, 3; breadth of ditto, 4 ft. 3 in.; length of fire-bars, 7 ft. 6 in.; number of flues, 16; internal diameter of ditto, 10 of 18 in.—6 of 14 in.; length of ditto, lower, 23 ft.—return, 30 ft. 2 in.; diameter of chimneys, 1 of 81 in.—1 of 77 in.; height of ditto, 32 ft.; area of immersed section at load draft, 536 sq. ft.; load on safety-valve in lbs. per sq. in. 25; heating-surface, 7,155 sq. ft.; contents of bunkers in tons, 800. Date of trial, July 29, 1858. Draft fore and aft, 15 ft. 6 in.

Frames, 17 in. by 10 in.; and 30 in. apart; number of bulkheads, 4; independent steam, fire, and bilge-pumps, 1; masts, 2; rig, brig.

Intended service, New York to Havre. C. H. H.

REVIEWS.

Comparative Philology. By Hyde Clarke, D.C.L. John Weale.

We have here another of Mr. Hyde Clarke's clever and very useful productions—clever in the learning and ability it contains, and useful in its popular intelligibility. The full title of the book is, "A Short Handbook of the Comparative Philology of the English, Anglo-Saxon, Frisian, Flemish or Dutch, Low or Platt Dutch, High Dutch or German, Danish, Swedish, Icelandic, Latin, Italian, French, Spanish, and Portuguese Tongues." Now, though the title is so long, and really not unnecessarily so for describing the book and its intended office, yet is the work truly succinct, pleasantly readable, facilely intelligible, and convenient for reference in its interesting and educational subject. It need hardly be said that of the several foreign languages named the Author does not affect to give or teach more than references to words and sounds in such languages cognate with words in English.

The character of handbook—he might say, waistcoat pocket-book—with which he starts he maintains, for into thirty pages covered certainly with but small yet clear type, Mr. Clarke compresses—1. A genealogical history of our language, in which he embraces a current allusion to the languages of the world; 2. Classification of the European languages, with prominently clear demonstration of the affinities with the English; 3. A succinct sifting of the modes by which the settlement of our language has been arrived at; 4. An intelligible explanation of prominent provincial dialects and their sources; 5. An essay on comparative philology, having, of course, special reference to the English language; 6. Tables of English words and the words cognate with them in those other languages named, such tables, with the points at which the Author aims, being thoroughly intelligibly shown, and, whilst curious, facile of comprehension. The terms of eulogy in which we speak of this unpretentious little book must not be attributed to favouritism, but to our warm feeling of approbation at seeing so much of research and learned acumen rendered so popularly intelligible and pleasantly attractive on the subject of our mother tongue.

We hold it to be of first importance that the means of communicating ideas by our vernacular language should be rendered certain; and there is not any calling or profession in which it is more important than to that of the engineer and artizan, that accuracy of means of communication should be surely, and, at the same time, currently attained. Bearing in mind, too, the vast variety of countries in which our callings are likely to be needed, and the difference of locality in our own island from which our native artizans spring, it must be found extremely useful that so happy a medium for amalgamation of terms as is furnished by our learned brother should exist. There may be a brother in other practical yet learned professions as well versed in the science of communication of ideas as the author under review, but, for ourselves, we must say such a one's name has yet to be introduced to us.

The present treatise by Mr. Clarke reminds us, and pleasantly so, of his compact dictionary, which passed under our review some few years since, and of the advantages found in that work, which we pointed out in our critique. Should he publish a further edition, we hope he may think it reconcileable with his plans to address himself especially to a full supply of technical terms applicable to the pursuits of the engineer and mechanic.

Returning directly to the work under review, we would say that we should like to see, and hope the public may be favoured by Mr. Clarke with, a work which shall be especially addressed to the connection of our modern English with the Greek and Latin languages,—words derived from, and compounds with those two languages, especially the former, comprising so many of our existing technical terms. We had marked passages in the present work for extract, and we should have much liked that our author should have spoken for himself, but on the one hand the limit of our space warns us that we must conclude, and on the other, the very moderate price of this very useful and instructive compendium places it so obviously within the means for possession of all our readers that we cannot, we think, better serve our friends, our author, and our subscribers, than by recommending their possessing themselves of this convenient handbook.

Five-Place Logarithms: arranged by Edward Sang, F.R.S.E. William Blackwood and Son, Edinburgh and London.

This will be found a useful aid to the engineers and others interested in exact calculations involving Logarithms. The author of the present waistcoat-pocket series of tables is well known for his useful arithmetical works, "Elementary Arithmetic," and "The Higher Arithmetic;" both of which are well known and highly esteemed class-books.

Weale's Engineer and Contractor's Pocket Book for 1859.

We have, just before going to press, received this useful work, the publication of which is looked forward to by civil and mechanical engineers, railway and public works contractors, and others, as one of the annual necessities of scientific men.

The most notable feature in the Pocket Book for 1859, appears to be, a reprint of the valuable Paper, by Mr. W. Fairbairn, F.R.S., on the "Resistance of Tubes to Collapse," which has but just now been published by the Royal Society.*

Cours Elémentaire d'Analyse, à l'Usage des Elèves de l'Ecole Navale et de l'Ecole Centrale des Arts et Manufactures. Par M. Meunier-Joannet, ancien élève de l'Ecole Polytechnique, Professeur d'Hydrographie, Chargé du Cours d'Analyse à l'Ecole Navale Impériale. 1 vol., 8vo, with numerous figures interspersed in the text. Arthur Bertrand, Paris.

This work (a more detailed notice of which we must defer to another opportunity), being specially intended for the use of students in the arts and manufactures, and in naval science, requires for its study an acquaintance with the first branches of mathematics—the first four operations in algebra, the resolution of equations of the first and second degree, the elements of geometry, and a competent knowledge of rectilinear trigonometry. The elementary course is preceded by a short and easy introduction, divided into three parts—1st. On the study of the conic section; 2nd. A demonstration of the binomial formula of Newton; and 3rd. First notions of analytic geometry, in which the student is initiated into the study of curves, represented by their equations. With the aid of the diagrams blended throughout the text, and of a kind of "aid-to-memory" table inserted at the commencement of the work, this book will serve as an excellent introduction to a complete course of analysis, and a preparatory training-exercise before attacking the intricacies of the differential and integral calculus.

The Rudiments of Hydraulic Engineering. By G. R. Burnell, F.G.S., Civil Engineer. Weale. Part I.

The author premises by his "Preface" that his book is "an attempt to bring together in its pages the consideration of the bulk of the subjects especially connected with building in water, or with the application of that fluid," and, to some extent, to make a rudimentary treatise, as far as possible, "complete in itself." Again, he says, "It is the province of an author of a rudimentary treatise to record universally-received theories on the subject on which he treats, and he is thus debarred from the expression of opinions which might afterwards be proved incorrect. I have therefore carefully avoided the introduction of controverted doctrines, and have unhesitatingly resorted to the common fund of scientific knowledge to be found in the writings of the most esteemed authors." These proper and sound suggestions Mr. Burnell has faithfully carried out in his compendious little work, and has so done it that the book may not only "guide the student in his future reading," but serve him also for a book of practice in the execution of his works.

A list of the authors consulted is promised, and a number of appropriate and especially intelligible diagrams are scattered through the pages. The departments, "Drainage" and "Applied Chemistry," are both treated of adaptably to sanitary measures. In the hands, therefore, of our sanitary improvers, this handbook of reference and practice may be useful and convenient. The thirty-five pages devoted to the important subject of "irrigation," in the course of which several clever, yet simple and practical, diagrams are introduced, must render the book essentially useful to the many persons whom we may well expect to be speedily addressing their time, talents, and capital to such improvements in India and elsewhere.

LIST OF NEW BOOKS AND NEW EDITIONS OF BOOKS.

PHILPS.—The Progress of Carriage Roads and Water Conveyances from the earliest times to the Formation of Railways: being a Section of Philps' "History of Progress in Great Britain." (Houlston.)

FERGUSON (J.)—Illustrated Handbook of Architecture: being an Account of the Different Styles prevailing in all Ages and Countries. 2nd edit. 8vo, cloth, 26s. (Murray.)

LANDELLS (E.)—Home Pastime, or Child's own Toymaker, with Practical Instruction and Illustrations. 5s. Also, by the same Author, the Boy's own Toymaker. Cloth, 2s. 6d. (Griffith, St. Paul's Churchyard.) [An amusing and instructive book for the young.—Ed.]

TRIUMPHS OF STEAM; or, Stories from the Lives of Watt, Arkwright, and Stephenson. Illustrated, 16mo, cloth, 3s. 6d. Coloured, 4s. 6d. (Griffith.) A book suitable for the young.

ORR'S CIRCLE OF THE SCIENCES. New edit., cloth, 5s. (Houlston.)

ENGINEER AND CONTRACTOR'S POCKET BOOK for 1859. (John Weale, 59, High Holborn.)

CORRESPONDENCE.

[*We do not hold ourselves responsible for the opinions of our Correspondents.*]—Ed.

THE WINANS STEAMER.

To the Editor of The Artizan.

Sir,—The naval architecture of the United States has been remarkable for nothing more than for its bold deviation from established types of form, and the disastrous consequences which have resulted.

We all recollect their "*kettle-bottom*" ships, which laboured so much in a sea way, with certain cargoes, as to jeopardize their masts. We cannot forget their "*long flat floor*" ships, with "a flat" extending from the "fore foot" to the stern-post which required, that their harpings immediately below the

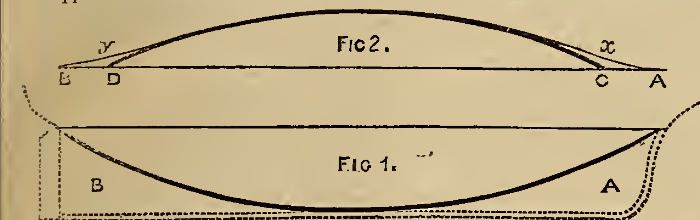
* A portion of this Paper will be found published in The Artizan at the end of 1857.

transom should be as fine nearly as those near the keel to admit of their rudders steering them. We have recently seen their much-vaunted *clippers*, the water lines of which have been (and not inaptly) compared to a longitudinal section of a wine bottle, thus rendering the limited buoyancy of their ends insufficient to sustain the superincumbent weight of poop and forecastle, and causing them to strain so enormously as to spoil their cargoes with the resulting leakage. But "Cousin Jonathan" appears to me to have given the "go by" to all his former *escapades* in the "*Winans* steamer," and at length to have arrived at the *ne plus ultra* of daring empiricism.

Were the water as quiescent as it is in the *vivarium* of a *virtuoso*, and the wind disposed to waft only the gentlest zephyrs, this prodigy of naval architecture would no doubt go very fast; for (as your readers have seen in one of my communications) assuming her circular midship section and her length, her form approximates to that which mathematicians have determined to be "the solid of least resistance."

Your numerous scientific and experienced readers connected with the marine of this country are quite as able to form an opinion for themselves upon the merits and defects of this novelty as I am; but as it is said our underwriters "would insure a rat afloat in a sieve,"—as our transatlantic cousins may probably introduce their "notion" to Lloyd's room,—and as a word or two in your columns would have the weight due to them, from the character of The Artizan,—I think good may result from your publication of the following hints:—

The Winans steamer is, with regard to her immersed body, the *essential trunk* of a steam ship, having those important adjuncts, *gripe* and *after-run*, lopped off. This is seen in an instant by the following sketch, Fig. 1.



The portions A and B, and the keel connecting them, are absent. Thus the vessel cannot be placed on a straight tier of blocks for repairs. When she is under way, the least lateral force of wind or wave will cause her to deviate from her line of motion; and no rudder will so control her as to prevent her course from being as wild and devious as that of a bacchanal after his most copious libations to the jolly god.

Ordinarily, the breaking in of the parabolic lines of the main body to the straight lines of the gripe and run aft—that is, to A and B—causes the naval architect to introduce his hollow water-lines at the two ends of the ship, below her load-draft, and I have not yet learned the utility of introducing them for any other purpose. Thus, if A B in Fig. 2 be the middle line, A being at the stem and B at the stern-post, a horizontal section or water-line of the main body may be conceived of as terminating at C and D, in which case all beyond at both ends would be mere external deadwood: to avoid this the two are united by the introduction of a concave curve, as at x and y.

Vessels have been built without either gripe or after-run, and those necessary appendages have been added subsequently, but secured in such a manner to the main trunk or body as to admit of the whole of the appendage at each end being knocked away without damaging either the middle line work of the ship, or disturbing any portion of her planking in the slightest degree; and such a plan may be re-adopted for both wooden and iron vessels.

The *meta centre* of the Winans steamer will obviously be in her longitudinal axis at whatever draft of water she may be placed, that is if all her transverse sections are, as they appear to be, circular. It is clear then that her stability will be in proportion to the distance of the centre of gravity of her whole mass below this line. By arbitrarily placing weight, of course, it is possible to give her great stability. But there must be room for the boilers and the working of the engine-machinery, and there must be a considerable space for coals. Now there appears to me to be considerable danger that the consumption of the latter, as the vessel proceeds on her passage, will tend to elevate her centre of gravity and make her crank, especially if goods be stowed in her upper part. I can hardly imagine that her coals will be so posited as to prevent this without stowing goods and stores in an utterly unusual way. At all events, an extraordinary amount of skill and care will be requisite to secure a necessary and constant quantum of stability.

But who are to navigate her? No masts or sails! What is to become of her if either her engine or propeller becomes disabled? Really this is a fearful consideration! It appears to me that, with anything like a sea on, the waves will break over her in all directions. What is to prevent them? Her form, as delineated in your columns, looks more like that of a vessel constructed for submarine purposes than of a "skimmer of the seas;" and one would wish that she should be manned with an amphibious crew, and that every passenger should be equipped with the dress of a diver.

I have said she may become crank, but, alas! what does that mean? vessels of the ordinary form when crank may be listed a streak or two to port or starboard, their planes of flotation becoming wider, the *meta centre* is thrown up, and stability results; but if once the centre of gravity of this vessel get above her *meta centre*, she will totally upset, without any intervening change in the position of her *meta centre* to check for a moment the inevitable catastrophe, in which case, unless I have misapprehended her form, or the ordinary principles of naval construction, she would become a floating mausoleum, with her bottom "gleaming in the pallid moonbeam." G. J. Y.

SPECIFIC HEAT.

To the Editor of The Artizan.

Sir,—To Mr. Lawrie's paper on the expansive working of steam, which you inserted in the last number of your magazine, there is appended a note, in which the author objects to the use, by Professor Thomson and myself, of the term (as he quotes it) of "negative specific heat."

I believe Mr. Lawrie's objection must have arisen from his overlooking the fact, that in a paper of mine in the "Edinburgh Transactions" for 1850, to which he seems to refer, and to which Mr. Thomson referred when he expressed approval of my views, the term employed by me is *not* "negative specific heat," but "negative *apparent* specific heat;" the word "apparent" being used to indicate the principle, that when a substance, such as steam, absorbs heat while its temperature is falling, that phenomenon does not arise from the real specific heat becoming negative, but from the disappearance of heat in producing mechanical work:—being the very principle which Mr. Lawrie's paper illustrates. I have from the first maintained, that the real specific heat of every substance is constant and positive.—I am, Sir, your most obedient servant, W. J. Macquorn Rankine.

Glasgow, 4th December, 1858.

THE WAVE-LINE.

To the Editor of The Artizan.

Sir,—May a reader of your Journal in the Far West take the liberty of requesting the favour of an answer to an inquiry respecting the "Wave-Line Principle," in its practical application to the building of yachts?

I have perused your Journal from 1851 to 1858 inclusive, and read the several articles contributed by Dr. Eckhardt, "Demerara," Moy, Armstrong, and others, but have failed to elicit therefrom sufficient information to design a yacht on the wave-line principle from keel to gunwale.

The brief question is, where can such information be obtained? I have examined the "Transactions of the British Association" from vol. i. to vol. xxi., and find therein frequent promises and postponements. Vol. xv., p. 112, of that series, contains a brief article "On the Sailing Powers of Two Yachts built on the Wave Principle, by Dr. Phipps, or a Mr. Beamish, of Cork, but without any illustrations or diagrams.

The "Civil Engineer's Journal," vol. vi., pp. 353 and 372, on the "Form of Ships," says,—"We think it desirable, in the absence of the voluminous report of the Committee, and drawings, which may not be published for years, to state at least some of the results," &c., &c.

I beg leave to ask if such results have yet been published?

Is the rule given in p. 372 of the "Civil Engineer and Architect's Journal," to be applied at the several streaks or heights from the keel to the light, or load water-line, and then to adopt any form from that line to the gunwale which the fancy or skill of the designer may dictate; or, to exemplify my meaning still further, suppose the breadth of the midship section at the light water line to be 10 ft., and the wave lines to be designed for that breadth, then, if midway between that line and the keel the section should be contracted to, say, 5 ft., is the same rule applicable at that part of the midship section, in order to constitute the true wave line?

I have the honour to be, Sir, your obedient servant,

Toronto, Canada West, Nov. 18, 1858. Ontario.

[Mr. Scott Russell's reply will be found in "Notices to Correspondents," in the present number.—Ed.]

ENGINEERING MEMORANDUMS FROM AMERICA.

To the Editor of The Artizan.

Sir,—In continuation of my previous communications about boiler explosions and other matters interesting to the engineering profession, I send you herewith a few jottings of those events which have occurred in this part of the United States during the month of November, 1858:—

I see by the "New York Herald" of November 7th that the propeller towboat *Petrel* exploded her boiler on the 6th, on the North River; three men lost their lives, while a fourth was badly injured. The body of the engineer was blown fully 100 ft. into the air, and in its descent fell upon the promenade deck of the steamer *Broadway*, crushing in the deck with its weight, and forcing its way through to the saloon below. Not a remnant of the boat was discovered except a few pieces of broken timber, and even these traces of the ill-fated boat soon floated off with the tide, and were lost to view. No cause can be assigned for the explosion, as there are none left alive who can throw any light upon the matter.

I perceive in the "Philadelphia Press" of November 12th that the boiler of the steam stave mill of Mr. Rich, at Moores, New York State, exploded yesterday morning; one man was killed, three others are not expected to live, and one is seriously injured, but may recover.

The "Philadelphia Ledger," November 18, says, the locomotive, "James Irby," exploded near Newberry, Georgia, on the 15th, killing the engineer and brakesman, and seriously wounding two others.

The "Philadelphia Press" of November 12th states, the Fox River Valley Railroad was sold by auction on the 10th inst. at Chicago; it was knocked down at *one thousand dollars*, for the benefit (!) of the first and second bondholders.

A new wooden screw-steamer, *Comanditaria*, built for Cuba, by Messrs. Cramp, of Kensington, Philadelphia, went on her trial trip on the 17th November; she is 180 ft. long, 30 ft. beam, 11 ft. hold. The engines (two) built by Messrs. Reaney and Neafie, of Kensington, Philadelphia, are vertical crosshead engines, each cylinder 40 in. diameter, 3 ft. stroke. They are condensing engines, and are geared $2\frac{1}{2}$ to 1 to the screw shaft. She ran from Philadelphia to Chester, $16\frac{1}{2}$ miles, against wind and with tide, in 1 hour 4 min.; back again, against tide, in 1 hour 25 min. Pressure of steam, 25 to 27 lbs. No. of revolutions of engines, 35 per min.

The wooden screw-steamer *Kensington* went on her trial trip on the Delaware on the 25th November. She is 1,200 tons burden; length of keel, 208 ft.; over upper deck, 216 ft.; breadth of beam, 32 ft.; depth of hold, 18 ft. Engine, inverted cylinder style, working direct on the screw shaft, 1 cylinder 56 in. diameter, 44 in. stroke; speed on trial trip 13 miles per hour. Hull built by Birely and Lynn, Kensington, Philadelphia. Engine by Reaney and Neafie, Kensington, Philadelphia. Built to run between Philadelphia and Boston.

In forwarding the particulars of the boiler explosions and other accidents connected with engineering and mechanical subjects, I do so from no desire to unfairly invite or challenge comparison to the disadvantage of American engineers and mechanical constructors, because, before any such invidious course should be adopted, I consider you should first "look at home," as there is very much that is very bad to correct there. My object has been rather to chronicle these occurrences in aid of your very praiseworthy efforts to post your readers up in what is going on throughout the world that may possibly interest, if not all, at any rate very many of the readers of The Artizan. This, I find, is being very successfully and more than ever done by the four or five pages devoted monthly to "Notes and Novelties."

Yours obediently,

An American Engineer.

Philadelphia, U. S., *November*.

NOTICES TO CORRESPONDENTS.

R. T.—We need only refer you to a pamphlet published by Mr. Charles Clifford, the inventor of the safety apparatus for lowering ships' boats. (Norie & Wilson, 157, Leadenhall-street, 1858.)

J. E. (Glasgow).—Many thanks for your obliging communication. We hope to hear more on the same subject.

R. H. D.—We take the hint, and will act upon it. We are obliged for the illustration and particulars from the other side. May not the defects of construction be the real cause of failure in most cases? The tendency of the present movement is certainly for a further increase of pressure.

W. F. B. (Calton, Glasgow).—Your request shall be attended to. The particulars were acceptable.

J. S. (Ronen).—We shall be happy to afford you the information required upon your stating what use is to be made of it.

C. Robertson (Birmingham).—You are quite right. Mr. Bramwell, Mr. Cowper, a Mr. Humphrey, and several others have expressed their opinion upon the Chillingworth Engine described at the last meeting of the Mechanical Engineers in your town. We have no doubt Mr. Chillingworth has ere this satisfied himself upon the subject.

N. P. B. (Sheerness).—By accident your letter of November 3rd escaped our notice for the December number. We refer you as to your first and second inquiries to Mr. John Bourne's work on the Screw Propeller. As to your third, it is evident your colours are of inferior quality. Try Rowney's or Newman's.

D. M. (Glasgow).—We omitted to thank you for the paper forwarded. We shall be glad to be favoured with any information which you can afford us on matters of local interest, or which may come under your observation.

E. P. (Marine Impériale, Paris).—Many thanks for your very valuable and much-esteemed communication, which was, however, received too late in December to enable us to do justice to the subject in our January Number. We shall treat the subject at length in our next.

G. (Cairo).—Many thanks for your promised communication. The information already forwarded has proved serviceable.

J. W. (London).—We shall be glad to be informed of the result of your experiments.

Dr. L. T.—We shall be glad to have your promised communication at your earliest convenience.

J. W. B. (Baton Rouge, U.S.).—We have not heard from you. We communicated on 22nd June, in reply to yours of 28th May.

C. E. (Washington, D.C. U.S.)—The information respecting the oil shall be sent to you in the course of a mail or two at furthest.

P.—We should recommend you to apply to Ellis & Co., Irwell Works, Manchester.

P. C. (Dover).—We give with this present Number an Illustration of a Bridge of the kind you refer to.

C. Hadley (Birmingham).—We have received several papers from you, but we cannot quite see how we can be of service to you in the affair.

P. J. C.—An apparatus has been patented by a Mr. Baines, of Manchester. Write to B. Fothergill, Esq., Queen-street chambers, Manchester.

J. S. W. (Birkenhead) will be answered through the post.

Ontario (Toronto).—Mr. Scott Russell's answer to your inquiry is—"The wave-line is to be applied to one chief water-line only, and those above and below it may deviate from it according to the other requisites of the ship."

Terry and Prince (Breech-loading Arms).—We must postpone publishing Mr. Prince's reply to Mr. Terry until our next.

[Correspondents whose communications are not here replied to will either be answered by post, or are reserved for next month.—Ed]

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c.

Under this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artisan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.—Ed.

Engineers and Contractors.—A case of some importance, involving the question of relative position and legal remedy, as between parties standing in the above relation, came (4th December ult.) before the Lord Chancellor, on appeal from the decision of Vice-Chancellor Stuart. The suit had been instituted by the plaintiffs (Scott and Another), contractors, for the purpose of obtaining accounts of works which had been done by them in the construction of certain reservoirs, &c., in the county of Lancaster, for and on behalf of the defendants, the Mayor, Aldermen, and Burgesses of the Borough of Liverpool, by whom one Thomas Hawksley, also a defendant, had been employed in the capacity of superintending-engineer of such works, and also on account of the monies due to the plaintiffs in respect of the same. By the terms of the contract, it was, amongst other things, provided, that without the certificate of the engineer of the defendants, as to the sufficiency of the work done, no money was ever to be paid to the plaintiffs. The plaintiffs' tender for the execution of the works (£56,262) was accepted. The defendants had (as plaintiffs alleged) from time to time paid them about £50,000 on account, such payments having been made in certificates given by the engineer; which certificates, however, they alleged were given to them at irregular times, and did not include all the works which ought to have been included; and that the engineer sometimes refused to give them any certificate of the amount justly payable to them, in respect of work done since the delivery of the preceding certificates, thereby preventing them from obtaining payment of that to which they were justly entitled. In February, 1855—the contract having been entered into in January 1854—the plaintiffs received notice from the Town-clerk of the Corporation of Liverpool that the contract (from alleged non-observance) on their part was to be determined, and that the Corporation would take possession of the works; and they, accordingly, did take possession. The plaintiffs then filed their Bill, praying, that the withholding of the certificates, by the defendant (the engineer) of the amount due to them for works executed under the contract might be declared to be a fraud on them—the plaintiffs; that they were entitled to receive such amounts, &c.; that an account might be taken of all works done by them since the date of last certificate; and that the defendants—the Corporation—might be ordered to pay the amount. The Vice-Chancellor, at the hearing, had held that, upon the terms of the contract, the agreement to pay was conditional, and that the plaintiffs were bound by the arbitration clause (to refer any disputes) contained in their contracts: and he had dismissed the Bill with costs. Hence the appeal. Subsequently, the Court adopted the view of the matter taken by the Vice-Chancellor, and dismissed the appeal.

Designs Act.—The Reversible Mantilla Shawl.—In the Court of Queen's Bench (4th December ult.), an action was brought by Mr. J. Norton, of Clayton West, near Huddersfield, against Messrs. Nicholls, Gow, and Morris, shawl manufacturers, at Glasgow, for the alleged infringement of a new design for a reversible Mantilla shawl, capable of being folded in eight different ways. The defendants alleged that there was no novelty in the design. After the examination of several witnesses, the parties agreed that Norton's shawl was "a new combination of old ingredients," and that with the exception of the pattern and colors, the defendants' shawl was substantially the same. A verdict was then entered for the plaintiff, with nominal damages, leave being given by the Judge (Lord Campbell) to defendants to move the court above, upon points of law, to enter the verdict for them, or for a nonsuit.

Railway Surveyors, &c.—Question of Liability for Accidents.—In the Court of Exchequer (10th December ult.), in an action for compensation (Maitland and Wife *v.* the Great Northern Railway), the special jury, after a long deliberation, handed in a written finding to the Lord Chief Baron. It was thus worded, "We think that the Surveyors and Engineers constructed the line according to the best of their judgment, and that the primary cause of the accident was from an unprecedented fall of rain that could not have been anticipated. The jury are unanimous in the above, but differ as to the negligence of the company—six being satisfied that the company have used proper vigilance, and six that they have not." His lordship then said that after the opinion expressed by the jury, and that opinion being the result of a long, and, no doubt, serious deliberation, he should not detain them any longer, but discharge them from giving a verdict.—They were discharged accordingly.

Uncoupling Trucks.—At the inquest, held 11th December ult., at Canterbury, on the workman who was killed whilst in the act of uncoupling one of a train of trucks while in motion, the jury returned a verdict of "Accidentally killed." The coroner, in his summing up, whilst he exonerated the South-Eastern Company from blame on this occasion, added "that the practice of uncoupling trucks whilst in motion, was, in his opinion, highly dangerous, notwithstanding the statement that had been made, that the practice in question was not at all dangerous."

Responsibility of Road-Surveyors.—Recently, a commercial traveller, on his road to Neyland from Haverford West, drove the wheel of his gig on to a heap of stones which had been placed in the centre of the road. He was thrown with great violence to the ground, and was conveyed to Neyland, where he died in two days. A coroner's inquest (says the "Cambrian") has since been held, and a verdict of "Manslaughter" returned against the road surveyor and contractor, who was at once conveyed to prison,

The Thrashing-machine Boiler Explosion near Nottingham.—The adjourned inquest on one of the sufferers took place on the 25th November ult. The seven men who were injured by the explosion have all recovered. The evidence went to show that the explosion was caused by the carelessness of one of the latter, he having neglected to open the safety-valve and let off the steam. A verdict of "Manslaughter" was returned against him, and he has been committed to the County gaol to take his trial at the next assizes.

Metropolitan Works.—The parish of Marylebone have recently taken legal steps (in the Queen's Bench) to quash a "Precept," issued by the Local Management Board, and addressed to the vestry (under the 19th Victoria), directing them to raise a considerable sum; one item of which, namely, £1,561 2s. 4d.—"the portion of the sum to be charged on the parish of Marylebone for defraying the expenses of the Board in the execution of metropolitan works"—is objected to. The item, it appears, is to be applied to the construction of the Victoria Sewer. On the motion for a Rule Nisi for a *certiorari* to bring up the "Precept" in question, "with a view to its being quashed in part or in whole," the parishioners contended that the Board had no right to charge the item, unless they (the parishioners) derived benefit from the object attained; and the parish of Marylebone derived none in this case. Ultimately, at the suggestion of the Court, the matter was directed to be turned into a special case for the opinion of the whole Court. The principle involved in this dispute is, undoubtedly, of great importance, as it directly affects the question of "centralization of power" in opposition to that of "local management."

Leaving a Train while in Motion.—At the Greenwich Police Court, a young woman was charged, on summons, with leaving a train, on the London and Brighton Railway, while in motion. The offence was clearly proved, and admitted by the defendant, who had a very narrow escape of her life, she having been thrown with considerable violence on her back at the Forest Hill Station, the train from which she alighted proceeding at great speed at the time. It appearing that a gentleman passenger had shown defendant the bad example of acting as she had done, by leaving the train before her, the Magistrate (Mr. Traill), after a few well-timed remarks on the folly of persons running the risk, as is too much the practice, of being either killed or perhaps injured for life, by endeavouring to save a few seconds of time, in jumping from carriages immediately on trains entering a station, said, that, as a caution to her and others, he should order her to pay a fine of 10s., and costs.

The late Accident on the Oxford, Worcester, and Wolverhampton Railway.—On the 30th November ult, at Stafford (Oxford Circuit), an indictment having been preferred against Cook, the railway guard, committed for trial for manslaughter in respect of the accident which occurred on this line 23rd August last, near Dudley, the grand jury threw out the bill. The announcement having elicited some slight feeling of applause in the court, the Judge expressed his disapproval of such manifestations of opinion in courts of justice. The case against Cook was withdrawn, and he was formally acquitted.

The "Great Eastern" steam-ship has already become the subject of litigation. In the Court of Common Pleas (16th December ult.), an action was brought (Martin and others *v.* The Eastern Steam Navigation Company) to recover the rent for the yard where the *Great Eastern* was built, from the 16th of October, 1857, to the 1st of March, 1858. The question of what amount was to be paid depended upon a vast number of details, and, having occupied the Court until its rising, the further hearing was postponed.

Railway Engineers' Fees and other Claims.—In the Court of Queen's Bench, 30th November ult., a case (Bruff *v.* The Eastern Counties' Railway) involving these questions was tried before Lord Campbell and a special jury. The plaintiff (Mr. Bruff) was chief engineer and superintendent of the Eastern Union Railway Company, at a salary of £800 a year, and, on the amalgamation of this company with the Eastern Counties Railway, at an additional salary of £1,000 per annum. The chief question in dispute was, whether the £1,000 a year was exclusive of the £800 a year for the Eastern Union Line (on which he still continued), or whether the salary was for the two lines. The other items of claim were for sums of money expended by plaintiff, in regard to parliamentary duties, under the direction of the company, and also for his own personal services in the superintendence of the new works required after his appointment. The entire amount claimed was about £6,000. After a lengthened investigation of these various claims, and an intimation from the Lord Chief Justice that it would be most desirable if the parties could arrange the dispute between themselves, a consultation was held between the counsel on both sides, and it was announced that the parties had agreed to a verdict for the plaintiff (Mr. Bruff) for £1,750. Verdict accordingly.

Railway "Fishes" and "Fish-joints."—Alleged Infringement of Patent.—In the Court of Queen's Bench (7th December ult.), a case of alleged infringement was opened, which occupied the Court for two days. The plaintiffs were the executors of the late Charles Heard Wilde; and they sued the Great Northern Railway Company, to recover damages for infringement of a patent which had been granted to Mr. Wilde in 1853, for "improvements in fishes and fish-joints for connecting the rails of railways." The patent had become the property of the "Permanent Way Association." It appeared it had been found advantageous to attach pieces of iron to each side of the rail, by means of bolts and nuts; and that such pieces of iron were called "fishes"—said to be derived from the French *affiches*; and the "fishes" so-called were used to attach the ends of the rails securely to one another. They were attached to the rails by means of bolts, which passed through the "fishes" and rail; the bolts having a square head at one end, and being secured at the other end by a nut screwed on to the end of the bolt. In screwing on these nuts, it was found that the bolt would turn round; the bolt being round, and passing through the "fishes" and rail by a round hole. To obviate which inconvenience Mr. Wilde formed a recess, or groove, in one or both sides of each "fish," so as to reduce the quantity of metal at that part, and to be adapted to receive the square heads of the bolts, and thus prevent them turning round when the nuts are being screwed on. Between 30,000 and 40,000 of these "fishes" had been used by the defendants upon their line. The defence was, that the so-called invention of Mr. Wilde was no invention at all; but merely the application to "fishes" for rails of a well-known and ordinary contrivance for preventing bolts from turning round when being screwed. Several witnesses for the defence proved that the contrivance had long been in use in various kinds of machinery, and in the construction of bridges. Lord Campbell left it to the jury to decide whether Wilde's process was new, or had been known before, and applied to other substances; and, secondly, whether there was any invention in the method in which Wilde applied it (by the addition of a groove) to iron rails. The jury ultimately found a verdict for the defendants.

Liability of Railway Companies for Certain Accidents.—In a recent case tried in the Court of Queen's Bench (Smith *v.* the Great Northern Railway Company), the jury, after an unusually protracted consultation, found for the plaintiff, with one farthing damages: a verdict which Lord Campbell refused to receive, as being "not reasonable." Ultimately, the jury, notwithstanding some very serious remarks by his lordship on the occasion, still persisting in their unwillingness to find any other verdict, the Chief Justice discharged them, adding "this trial must go for nothing." The action had been brought by Mr. Smith, a commercial traveller, to recover compensation for injuries sustained whilst travelling on the Great Northern Railway. The defence was, that the accident to the train in which plaintiff was a passenger, was to be attributed to the unprecedented floods in the neighbourhood where it happened, and not to any negligence on the part of the company. Two other juries, it appears, have, on this very question, been discharged, as not being able to agree on their verdict. Lord Campbell, in the course of his remarks, announced his intention to introduce a measure for a legislative remedy (in civil cases) for the inconvenience arising from the present state of the law which requires unanimity in the verdict of juries.

The Lace Trade.—Fisher and Gibbon's Patent.—A case, of considerable importance to patentees, came recently (29th November ult.) before the Lords of the Judicial Committee of Privy Council, on the petition of John Fisher, of Carrington, Nottingham, for the prolongation of a patent granted to him and Mr. James Gibbons in 1844, for improvements in the manufacture of figured or ornamented lace or net, or other fabrics. The invention consisted; first of improvements in the manufacture of figured or ornamented lace or net, or other fabrics, by working ornamental figures or designs by machinery, in such manner that two threads are caused to loop together—one passing through the fabric, the other looping with that thread, and the two together, producing ornaments in loopwork on the surface of the fabric. Secondly, causing threads of gimp or yarn to be sewn in pattern on such fabrics by machinery. Thirdly, causing the machinery to be governed by Jacquard or perforated cards, with rollers, so as to give varied movements. Fourthly, that two or more warped threads might be used in making lace or net. And, fifthly, in governing the working of the warp threads by independent instruments. The ground on which the application for an extension of the patent was now made was, that, owing to a suspension of the use of the patent while it was out of his hands, the petitioner had not received a fair and proper reward for the invention, which was of great public utility and value; that this non-user accrued through no fault of the petitioner, and that it was the foundational patent of all the two-thread sewing-machine inventions; he (Mr. Fisher) being the first known inventor of the interlooping and interlocking stitches, and of the mechanical means of producing them. Sir Peter Fairbairn, Mayor of Leeds; Mr. Wm. Fairbairn, of Manchester; Mr. Benjamin Fothergill, C.E.; Mr. William Smith, C.E., and several eminent manufacturers from Nottingham, were examined in support of the petition, and proved the novelty and value of the patent. The petition was opposed on behalf of Mr. Thomas, the patentee of the sewing-machine. The decision of their Lordships was,—that notwithstanding the great merit of the invention, and the very high opinion which their lordships entertained for the great originality and surprising talent of the inventor for having originated the novel mode of combining two threads together for the purpose of sewing, or combing or ornamenting fabrics; and also for having afterwards produced the very ingenious mechanism for making those stitches, as well as for making and ornamenting lace during the process of manufacture; still the non-user of the invention during a period of ten years, whilst the patent was out of the inventor's possession (although neither the inventors nor any one else appeared to have reaped any reward from the invention, but, on the contrary, had incurred great outlay in connection therewith), did not afford sufficient ground to induce them to depart from the precedents which their lordships had adopted; and therefore, on the ground of non-user for the period stated, their lordships refused the application.

In the Common Pleas (21st December ult.), an action was brought by a draper, at Shrewsbury, against the London and North Western Railway Company, to recover damages for injuries sustained by him while travelling on their line (4th October, 1857), about 4 miles north of Rugby. On this occasion, the shackle, or coupling-iron, which connects the engine with the carriage, had broken: the result was an internal collision, and a sudden shock to the carriages forming the train, which ran into its own engine. Some of the carriages became detached and rebounded "with a kind of seesaw motion, one against the other." It appeared also that the side-coupling chains between the tender and the break-van were not, on the present occasion, attached; and evidence was adduced by the plaintiff to show that had they been used, the accident would, most probably, not have happened: inasmuch as, when the screw-coupling broke, they would have taken its place and performed its duties. Engineering evidence was given that, as a precautionary measure, the side-chains should always be attached or linked. The defendants, on the other hand, justified the disuse of the side-chains, by urging that as their action and strain were unequal, they were actually detrimental in going round curves; at all events, when applied to the connection of the tender and the break-van. During the rigorous cross-examination of the plaintiff and his witnesses (with the view of showing that the alleged damage which he had sustained, as well immediate as from the loss of business which had resulted, were much exaggerated), an arrangement was announced as having been made, by which the Company consented to a verdict for £1,350. "The plaintiff was injured on their" (the defendants') "line, and they were willing to waive the question of negligence." Chief-Justice Cockburn—"Such being the case, I deeply regret that it has been thought proper by your (Mr. Mellor's) clients, to impute to the plaintiff conduct of the most scandalous nature." Verdict for the plaintiff. Damages £1,350.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

We have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "18, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

A Project for Tunnelling Deserts has been started by a French engineer. He proposes, seriously, the scheme of turning the sands of the African desert into solid lumps for the construction of a tunnel. The sands are to be fused by concentrating the rays of the sun by means of an Archimedean mirror. Thus, arched blocks are to be cast, which, placed one against another, will form a tunnel as far as the desert extends. This tunnel, protected against the simoom and flying columns of sand, and supplied with water from artesian wells, is to be the grand central artery of Africa, and by establishing a communication between the north and centre of Africa, make Algeria the entrepôt for the commerce of the Mediterranean, with all the regions of the South,—a most magnificent scheme, we must admit, if, peradventure, it does not turn out to be based, in more ways than one, on a sandy foundation.

The Great Bell of Sherborne, hitherto well known to antiquarians as being the gift of Cardinal Wolsey, and the pride and boast of the town, met on Sunday evening, 5th December ult., with an irreparable disaster. As the ringers were ringing for service, it cracked, so that it is no longer, says the "Bath Chronicle," fit for use.

The Old "Victory."—A "memorial table" has been made of the original timbers of this long-cherished relique of Nelson's fame. In the construction of this table (by the joiners of Portsmouth dockyard, and destined as a present to the Junior United Service Club, Pall-mall), no wood has been employed but that which was in the ship at the battle of Trafalgar. It is 18 ft. long, 10 ft. wide, and 3 ft. 1 inch high, supported on six massive, handsomely-turned legs. All the models of the ships engaged in the ever-memorable action, are to be placed upon the table, which is panel-tapped, and fastened by screws or screw-bolts, made also of copper, which was in the ship in the height of her glory.

Timber from Sawdust.—There is much talk in Paris of a new process, combining the hydraulic press and the application of intense heat, by which the particles of common sawdust are made to re-form themselves into a solid mass, capable of being moulded into any shape, and presenting a brilliant surface, a durability, and a beauty of appearance not found in ebony, rosewood, or mahogany.

Canadian Timber Trade.—Quantities made for shipment, last spring, from the Ottawa and Trent:—Ottawa, 14,500,000 cubic ft. of white pine; Trent, 1,855,000 cubic ft. of ditto; Ottawa, 985,000 cubic ft. of red pine; 555,000 cubic ft. of aloe, and 100,000 cubic ft. of tamarac: besides large quantities of these woods from other districts of Canada, west and east, with black walnut, birch, &c. From New Brunswick, the shipments are nearly as great as from Canada.

A "Standard Hundred" of spruce deals is 120 deals, each 12 ft. long, $1\frac{1}{2}$ in. thick, and 11 in. wide.

The Great Bell "St. Stephen."—A second and more continued trial of the tones and power of this our modern triumph of bell-founding, took place on Sunday afternoon, 28th November ult. The experiments were tried by the clapper, and not by the six-hundred weight hammer. The tones of the new bell are much more mellow than were those of his ill-starred predecessor "Big Ben," owing to the fact that the former is more than $2\frac{1}{2}$ tons lighter than was the latter; the respective weights being "Big Ben," 15 tons 18 cwt. 1 qr. 22 lbs.; "St. Stephen," 13 tons 10 cwt. 3 qrs. 15 lbs.

Iron Strong-room for the Gold-fields.—A large iron fireproof strong room has just been manufactured, by Messrs. Chubb and Son, for the Bank of British North America, and shipped to Vancouver's Island. The room is 7 ft. high, 9 ft. 4 in. deep, and 7 ft. wide, constructed entirely of wrought-iron, and lined with fire-resisting materials. The interior fitted with nineteen separate and distinct lock-up safes, besides shelving for books and papers. The exterior secured by two large folding-doors, having three detector-locks, throwing twenty bolts all round. The room was shipped in parts, and will be fastened together from the interior, on arrival at its destination. Total weight 13 tons $\frac{3}{4}$ cwt.

Cloth Cutting and Sewing by Steam-Machinery.—Mr. Tait, an extensive army-clothier, states, in his evidence before the Army-Contract Commission (7th December ult.), that the whole of his clothing is cut and sewn by machinery driven by steam, and capable of making 4,000 suits a week * * *; that, on an emergency, with the steam-power at his command, he could furnish 10,000 suits a week to the Government. He employs about 1,100 people, and no man at wages lower than a guinea a week. As an illustration of the value of steam-power in this particular trade, he added that, on the evening of the 22nd May last, he received an order, in Limerick, from the War Department, to supply 800 regimental suits with the greatest expedition. He telegraphed to England for the materials he required, and had them brought to Limerick, the greatest part of the way by an express train; and, on the morning of the following Friday, he despatched, by express-train from Limerick to London, the whole 800 suits complete.

The Iron (Export) Trade.—The Liverpool merchants, engaged in the iron trade, have recently memorialised the Mersey Docks Board, requesting that some space may be allotted for their accommodation in the vicinity of Wellington or Bromley-Moore Docks, in order to form a depôt for iron brought from the interior, and intended for export. The memorial is understood to have met with a favourable reception by the individual members of the Board; on the understanding, however, that the trade be willing to pay a small rent for the required accommodation.

Paris Consumption of Wrought and Cast Iron.—From official returns, it appears that 957,955 kilogrammes of wrought iron, and 703,800 kilogrammes of cast iron, suited for building purposes, entered the gates of Paris during the month of September last, showing a diminution of 29,161 kilogrammes in the wrought iron, and an increase of 13,701 kilogrammes in the cast iron as compared with the corresponding month of 1857.

A New Army Clothing Establishment at Pimlico.—From the evidence before the recent Army Clothing Commission, it appers that the Government have rented Mr. Cubitt's premises in Pimlico for £1,800 a year, and they are to be converted into a clothing department.

Sculling Machine.—Under this title, the "Greenock Telegraph" notices a novel mode of propelling a boat, the invention of a Mr. Buchanan. It is wrought by two levers; but instead of the paddle being placed in the stern, it is placed in the middle of the keel.

The New Main Drainage of London Works are in course of commencement, if not in actual progress. The Northern High Level Sewer Works (the first portion of the undertaking) will extend over 8 miles, 4,295 ft. of ground, the main line being somewhat more than 7 miles, and the shorter line, called the Wickham Branch, rather more than 1 mile. At one point of its course, the main line of sewer will cross under the North London Railway, the sleepers supporting the rails of the latter, being about on a level, as regards one branch of the great drain, with the crown of the arch of the sewer, the brickwork of which is to be brought up to support the ends of iron girders upon which the sleepers are to rest, whilst the traffic of the railway is not to be interrupted—no slight specimen, by the way, of some of the engineering (but anticipated) difficulties which will beset the completion of the new Metropolitan Drainage plan. Generally speaking, the lines are made to coincide with those of existing streets and roads; and there appear to be but four or five houses which will require to be taken down and rebuilt. The conditions of this first portion of the work, the drawings and specifications of which are prepared, bind the contractor to finish the whole within 15 months after receipt of the engineer's order to commence, or to pay £50 as liquidated damages for every day over the time.

The Coal Whippers of the Port of London (Saturday morning, 11th of December ult.) struck for an advance of wages. They have been paid 6d. per ton for whipping coals for some time, although their pay for the same work was formerly 13½d. They demand 8d. per ton.

The India Transport Service.—The Overland route is still adopted by the Government for the transport of troops to India, although not to so great an extent as heretofore. During the autumn the "Hindostan" and "Oriental" Steam Navigation Company's vessels have been specially engaged in the conveyance from Suez to Calcutta and Bombay of troops brought to Alexandria by Her Majesty's ships, or steamers employed by the Government.

The Number of Officers and Men who have embarked in the Peninsular and Oriental Steam Navigation Company's steamers at Suez, during the twelve months ending the 30th September ult., stands thus:—

	Officers.	Men.
By the Company's Mail Steamers	172	3,343
By the Special Steamers	161	4,514
Total	333	7,857

The *Hindostan*, *Oriental*, and *Pottinger* are at the present time engaged in this service.

The Mauritius Steam Postal Service.—The tender made by the Peninsular and Oriental Steam Navigation Company for a monthly line between Mauritius and Aden, having been sent out to the colony for the consideration of the local authorities, and recommended by them to the Home Government, has been accepted,—the annual payment for this service is £24,000,—and, in connection with it, the Company have agreed with the French Government to convey the mails to and from the Island of Reunion for £12,000 per annum.

The Australian (Steam) Postal Service.—The tender, by the same Company for this new service, at £180,000 per annum, has been accepted by the Government.

Great Exhibition of 1861.—The Crystal Palace Directors have made a proposition to the Society of Arts to enter into arrangements for holding the forthcoming Art-Exhibition in the Crystal Palace.

Export Trade to India and the East.—The exports from England to Calcutta, Madras, and Bombay, for eleven months of 1858, were 409,957 tons of goods, valued at £12,082,584. To Ceylon, Hong Kong, and Shanghai, 57,553 tons of freight, of the declared value of 8,584,290. Adding cargoes to Singapore, Burmah, and other eastern ports, the total exports to the East, for the present year, amount to about 600,000 tons, of the declared value of about £20,000,000. The Overland route traffic and merchandise are not included in the above.

A Pneumatic Parcels Delivery Company is amongst the schemes to be submitted for parliamentary sanction in 1859. The Promoters propose to lay down pipes, like the gas and water companies in the streets of the metropolis.

An Omnibus Subway Company proposes to construct a subterraneous roadway from Westminster to the Royal Exchange, solely for the accommodation of the omnibus traffic between these two points.

Cast-iron Columns.—Twelve cast-iron columns, said to be the largest in the United States, are now in process of construction at Cincinnati. They are cast 50 ft. in height, 4 ft. 4 in. in diameter, weight between 200 and 300 tons, and will cost about 30,000 dollars. They are designed for the State House, Madison, Wisconsin.

A New Steering Apparatus, suggested by Vice-Admiral W. F. Martin, the Senior Naval Lord of the Admiralty, was tried on board the *Termagant*, 25, taken out of Portsmouth harbour for the purpose. The alteration consists of a yoke, with a cross-lever attached to the head of the rudder, with other gear. This can be, if needful, connected with the wheel, now in almost universal use. The ship can be steered on the lower deck by a tiller, as usual in most ships. Scientific officers, who have tried the new arrangement, have pronounced it a decided improvement both in making the ship answer her helm quickly, and as obviating the danger of throwing a man over by the sudden jerk of the old tiller.

Photography by Artificial Light, instead of the rays of the sun, has been successfully accomplished by Mr. Moule, with the aid of his newly-invented apparatus, lectured upon by the inventor, at the Polytechnic Institution.

The (Alleged) New Life-preserving Raft, composed of a matress filled with cork shavings, has been claimed as the invention of Captain W. Urquhart of New York. This, however, has been disputed on behalf of a new claimant, Mr. James Washington, a young working man of Liverpool, who, as it is alleged, described "the very same thing" in a paper read, about two years ago, before the Royal Institution of that town.

Deep-sea Pressure.—According to the "Boston Transcript," Lieut. Dayman, in one of his deep-sea soundings on the Telegraphic Plateau, hauled up 200 fathoms of sounding-line in a coil as heavy as lead, from the bottom. A piece of pine-plank, sunk to the depth of 500 fathoms, hauled up and thrown overboard, will sink like a stone.

A Dredging Machine, to cost £7,035 (constructors Messrs. Fawsett, Preston, and Co.), has been ordered by the Liverpool Docks and Harbour Board.

The Smoke-Nuisance.—At Stockport, two firms have been summoned before the magistrates, for using furnaces at their works, not constructed so as to consume their own smoke, "whereby a great nuisance is caused from the dense smoke emitted from their factory-chimney." The sanitary inspector having proved the case, and the defendants having promised to do all in their power to comply with the provisions of the Act of Parliament, the cases were dismissed on payment of costs.

The New Gutta-percha Life-boat.—Some recent experiments have been made at Liverpool to test the efficiency of Larchar's Patent Gutta-percha Life-boat. The body of the boat is entirely of gutta-percha composition, of about 1 in. in thickness; the interior fittings, seats, thwarts, &c., being of wood; while the air-chambers, one at each end, are of metal. Alleged advantages of the new construction, impenetrability, irrefragability, lightness and buoyancy. Experimental boat 16 ft. long, 5 ft. beam, and 3½ ft. deep. First test (a severe one) was the letting it fall into the water, from the davits, from a height of about 16 ft. It fell with tremendous force upon the water; but the boat was not affected in the slightest degree. Several seamen then got into it, filled it with water, turned it over, and used every effort to submerge it, but in vain. It was then hauled on deck, turned upside down, and its composition sides battered with a heavy hammer, without producing even a dent in the gutta-percha.

Land Drainage in Greece.—The offer recently made by Mr. Webster to the Greek Executive to drain the Lake Copaïs into the adjacent Sea of Eubœa, or Negropont, has, unaccountably it would appear, been rejected by the Hellenic Government. The water in question covers over 100,000 stremata of good land, and the offer made by the English speculator secured unquestionable pecuniary advantages to the Greek Government (£30,000 sterling for the tenure of ten years), the proposer undertaking all the works at his own cost. They higgl d about it, and the Englishman has left in disgust.

RAILWAYS, &c.

A Collision on the North-London Railway occurred (6th December ult., about 6 o'clock p.m., during the thickest of the fog), at the Hackney station of the North-London Railway. A passenger-train from the Hampstead-road station to the City, did not start for some time after its proper period. It arrived at the Hackney station a few minutes before 6 o'clock, and was standing still, putting down and taking up passengers, when an engine was heard approaching the rear of the train. The dense fog then prevailing prevented all view of the head-lamp of the engine, until it had reached within a few yards of the station. Red signal-lamps were waved, and the driver was shouted to; but, unable to check his speed (between 10 and 15 miles an hour) he ran with fearful force into the rear of the train. The last carriage, a second-class, was shattered to pieces, and its passengers hurled in all directions. The next, a first-class, was also shattered; a third from the rear, a second-class, likewise suffered. Scarcely a passenger in these carriages escaped injury: the more serious cases were conveyed on stretchers to the hospital at Dalston. The engine which ran into the train was a "heavy-goods' Pilot." By this accident twenty-two persons were more or less injured.

Another Collision [at Lea-Bridge, on the Eastern Counties Railway], took place on the same day. The 5.20 passenger-train from Shoreditch was run into by a luggage-train, which, it appears, by mistake, had been despatched too early after the former train had left the Stratford station. In the last carriage several passengers were seriously injured. The 4.5 p.m. train from Bishopsgate had broken down, during the dense fog, between Lea-bridge and Edmonton; and the four following trains, including the 5.20 had all been brought to a standstill at or near Lea-bridge Station. The goods' train that caused the mischief consisted of forty carriages propelled by two engines, and had been despatched from Stratford during the dense fog, within from 3 to 5 minutes after the 5.20 passenger-train had started thence.

Railway Accident in Lincolnshire.—On the 6th December ult. as the train from Manchester to Hull, starting at 9.15 a.m., was proceeding between Gainsborough and Blyton, at ordinary speed, the tire of a first-class carriage-wheel flew off. The driver immediately pulled up, and, beyond a fracture of the rib to one of the passengers, no very serious injury occurred either to train, carriages, or rails.

Conway Railway Station, on the Chester and Holyhead Railway, has been almost totally destroyed by fire. On the 20th November ult., about 2 o'clock in the morning, the station-master was aroused, being nearly suffocated by smoke. Finding the station was on fire, he removed his family and gave the alarm: but, unfortunately, no fire-engine could be procured, for this simple reason, as it appears (so says the "Manchester Guardian") that the town does not possess one. It is inferred that the fire originated in the upper part of the station.

The Danube and Black-sea Railway Company is understood to be making very satisfactory progress. Sufficient labour is attainable, and the necessary lands have been secured. The cost of the line is to be £230,000; and traffic, it is expected, will commence in the spring of 1860.

Accident on the Garston and Warrington Line.—A serious accident (fortunately unattended with loss of life), occurred 24th November ult., at Sankey Bridge, occasioned by leaving open of the canal bridge, across which the railway passes. The engine of the night express to Garston was returning about 2 o'clock in the morning, the weather being so foggy as to prevent the driver observing any signals that might have been placed for his guidance. The bridge, it appears, had been left open for the passage of flats along the canal. The engine, a powerful one, driven at considerable speed, crossed the bridge at right angles with the rails, breaking and bending them like laths, and was precipitated into the canal with a fearful crash, the tender, however, remaining upon the bridge, and not altogether detached from the engine. The driver and stoker escaped unhurt.

Accident on the London and North-Western Line.—As the goods' train from Manchester (23rd November ult.), was approaching the Glaithwaite station, the driver, fearing a collision with a coal-train that was being shunted off the line, leaped off his engine, fell beneath the train, and had his right leg crushed below the knee. Amputation was deemed unavoidable.

Collision at Birkenshaw, near Bradford, on the Leeds, Bradford and Halifax Junction Railway.—A coal-train was being shunted (24th November, ult.) on to a sliding about 300 yards, on the Drighlington side of the station, as the passenger-train from Ardley was due. The two trains came (as is supposed from the denseness of the mist prevailing at the time) into violent collision. Guard of passenger-train severely injured, as likewise some of the passengers. The fault appears to have consisted in shunting the coal-train at the time the passenger-train was due.

The Paris and Lyon Railway appears to be fast recovering from its financial depression. At the end of the first six months of the present year, the traffic on this line, as compared with that of 1857, presents an aggregate decrease of £120,000, the whole of which has since been recovered; the increase for the 3rd week of November last, was 150,000 fr., or £6,000 sterling.

Railways in Chili.—The Government of this Republic are, through their special agent, Don Silvestre Ochagavia, in Europe, negotiating with Messrs. Baring Brothers the loan of seven millions of dollars, authorised by the law of 5th November, 1857, for the completion of two railways now in progress, and in which the state of Chili holds a considerable amount of shares. The loan appears to be favourably entertained in this country.

Sicilian Railways.—The Neapolitan Government has recently decided that no foreigners, of any nation, shall be employed in public works in the kingdom of the Two Sicilies; nor are railways to be contracted for and built by strangers.

THE KUSTENDJE [TURKISH] RAILWAY is (by recent advices) in active progress, the works on it being prosecuted with activity, and even the winter weather, which had begun to set in with remarkable severity, is not allowed to stop them. Surveys are likewise being made for the construction of other lines to branch off from the Kustendjé, and the Porte, it is said, has granted a concession for one in the province of Broussa.

ROLANDSECK TO COBLENTZ.—This section, completing the line between the latter city and Cologne, was opened on the 11th November ult.

A METROPOLITAN SUBWAY RAILROAD is likely to be constructed shortly. It is to intersect the Metropolis, so as to carry merchandise, cattle, and market goods by night, and passengers and parcels by day, from railroad to railroad, and suburb to suburb, and to and through the City, by frequent and regular convenient trains, carrying large numbers at a very low charge, and thus relieving the now intolerably overcrowded streets of many of their obstructions. Resolutions, approving of such a subway, were passed at a most influential public meeting of the citizens of London, convened by the Lord Mayor and presided over by him (1st Dec. ult.), at the London Tavern. The meeting, including Lord J. Russell, Mr. Crawford, M.P., Baron Rothschild, M.P., &c., cordially approved of the plan (originally proposed by the City solicitor, Mr. C. Pearson), and a Committee of Requisitionists was appointed to take the necessary means for carrying it into effect; one, and it would seem the principal, of such measures being the subscription by the Great Northern and the Public of £475,000, in shares, in aid of the like sum already subscribed for by the Directors and Shareholders of the Metropolitan Railway Company for the object referred to.

THE LONDON AND BURY ST. EDMUND'S [PROJECTED] RAILWAY is, from its extent, one of the most important undertakings of the present season. Length of the entire line, from Fenchurch Street Station to Bury St. Edmund's, 66 miles 3 furlongs; deepest cutting, 28 ft.; highest embankment, 40 ft. The new line is to join the Eastern Counties Railway at Ilford, 6 miles from London. To cost 7,000 per mile.

RAILWAY "BARRING-OUT."—THE "DON PEDRO SEGUNDO" RAILWAY.—At Rio, by recent advices, great excitement has been occasioned, in consequence of a dispute between the directors of this line and the contractor for the first section, Mr. Price, an Englishman. The Company attempted to take forcible possession of the last portion of the section, which the contractor would not give up until his pecuniary claims were previously discharged; but the Company were defeated in their attempt, Mr. Price's agent having taken down the girders of a bridge, which impeded the further progress of the trains. On this the Brazilian government interfered, by giving its guarantee for payment, on which the line was duly delivered up to the Company.

THE NORTHERN [OF FRANCE] Directors have prepared a plan for the new terminus which is to be constructed next spring. It is to be a grand building, the façade of which will be three times longer than that of the Strasburg railway, to be divided into seven separate buildings, of which the centre will serve as a vestibule for the passengers arriving by the various trains.

ST. QUENTIN AND ROUEN, THROUGH AMIENS.—The works of this railway line, which is to connect these places, are commenced, and will be completed, it is confidently expected, in two years at the latest.

FATAL ACCIDENT AT THE WORCESTER AND HEREFORD RAILWAY WORKS.—*One Life Lost, another in Peril.*—At the junction of this new line, now in course of construction with the Oxford, Worcester, and Wolverhampton Railway, near the Worcester Station of the latter Company, a very deep cutting is being widened, the men being employed at a great elevation, on a narrow ledge of marl, undermining what is above them. Recently, whilst so occupied, a large mass of earth fell upon them, killing one man on the spot, and injuring several others. This is the third fatal accident of the kind at these works.

TRANSIT THROUGH EGYPT—SUEZ RAILWAY.—In anticipation of the completion of the Egyptian line to Suez by the close of the year, when a continuous railway transit will be formed between the Mediterranean and the Red Sea, thus extending the traffic between Europe and the East by the Overland Route, the Directors of the Peninsular and Oriental Steam Navigation Company have decided on sending a deputation to confer with the Government of His Highness the Pacha, on the subject of the general management and tariff of charges to be adopted.

THE SUEZ RAILWAY, according to a telegram from Malta, to the 4th December ult., was just approaching completion, and the line was to be opened throughout in the course of a few days.

THE AUSTRO-ITALIAN SCHEME OF RAILWAYS [ROTHSCHILD TALABOT COMPANY].—An effort in the direction of Free-trade has (in favour of these particular lines) been made by Austria: half of the duty has been remitted on the foreign iron rails and locomotives required. The forge-proprietors of Carinthia are angrily remonstrating against this exceptional concession, and clamouring for "protection."

AMERICAN LINES.—Since 1830, nearly 27,000 miles of railroad have been formed in the United States, having cost, on an average, 35,000 dollars per mile, or, in the aggregate, 945,000,000 dollars.

A MODEL RAILWAY.—The West Flanders Railway, a little unpretending Belgian line, is thus (and, we believe, truly) described:—"It has virtually closed its capital account; never has had an accident—assiduously cultivates a small traffic—maintains the best of terms with adjacent lines—keeps to its own territory—never dreams of an extension—and opens its arms in the most friendly manner to receive all the traffic which it may be favoured with by its neighbours." It is, consequently, proposed as a model line to some, shall we say most, of our own railway boards, on the score of thrifty and successful management.

RAILWAY TRAFFIC.—The railway receipts for the current half-year amount to £8,557,389, against £8,629,260 for the corresponding period of last year; showing a total decrease of only £71,871, notwithstanding the dulness of trade.

MILEAGE.—December, 1858—8,815 miles, against 8,577 miles in corresponding week of 1857.

LOMBARDY—AMALGAMATION OF LINES.—The Emperor of Austria has (4th Dec. ult.), sanctioned the charter of the "Southern Railway Company (Amalgamation of Railway Companies in Lombardy)."

NORTHERN BENGAL [FROM RAJMAHAL TO DARJEELING].—This line has received the sanction of the Bengal Government, and is to be constructed for military and political purposes.

TELEGRAPH ENGINEERING, &c.

TURKEY.—Several engineers, or representatives of companies, are, says the "Gazette du Midi," making application to the Porte for the construction of lines of telegraph in Europe and Asia, both in the interior and on the coast.

INDIA.—Sir W. B. O'Shaughnessy, the Superintendent of Electric Telegraphs in India, has been congratulated by the supreme Government of India for having completed the telegraph from Kurrachee to Bombay, and for laying down the cable across the Gulf of Manaar.

CANEA (IN CANDIA) AND ALEXANDRIA.—The sinking a telegraph cable between these places has commenced. By advices to the end of November last, the operation was proceeding favourably.

THE DARDANELLES, SYRA, AND CHIO.—A recent telegram, dated Constantinople, November 27th ult., announces that a submarine telegraph between these places has been successfully laid.

CANDIA AND EGYPT.—The cable between Candia and Egypt has been broken.

CAPE HELLAS TO ALEXANDRIA.—According to the terms of concession by Turkey for this line, no time is fixed within which the cable must be laid; but in the concession of the Red Sea line the permission is forfeited, if the former (from Hellas) is not laid in two years after the 24th December, 1856. A further reasonable delay will, it is confidently expected, be granted by the Turkish Government.

THE ATLANTIC TELEGRAPH CABLE appears to be a hopeless failure. The question of replacing it has been brought before the public. The Company, it is understood, have applied to Government for a guarantee of $4\frac{1}{2}$ per cent. on £537,000, subject to the same conditions as that of the Red Sea line; and this has been backed by memorials from London, Manchester, Liverpool, Birmingham, Leeds, Glasgow, Paisley, the Belfast Chamber of Commerce, &c., &c. If the application be successful, contracts are to be immediately concluded for a new cable. All opinions as to the real cause of failure in the old one continue to be merely conjecture. On the 6th December ult., the whole of the Atlantic Telegraph staff had left Valentia. with the exception of one member, who was to remain in charge during the winter. From what transpired at the meeting of this company on the 15th December ult., it appears that the capital received and expended was £379,029. only £7,996 (balance of which) was then in hand; and that the directors had made application to the Government with a view of a guarantee being afforded for raising the remainder of the capital, viz., £537,140, as the same advantage had already been conceded to the Red Sea Telegraph Company. No definite arrangement on this head had as yet been come to.

ISLE OF WIGHT.—The cable which had been seriously injured by a vessel fouling it with her anchor, has had to be hauled up, landed, repaired, and laid down again; all which operations were so speedily performed that, on the 7th December ult., telegraphic communication with the main-land was reopened.

PARIS (December).—Workmen are busily engaged in placing the wires for the electric telegraph along the line of the fortifications of Paris. The posts have already (11th Dec.) been placed for twenty-one wires along the eastern part.

THE SEMAPHORES BETWEEN LIVERPOOL AND HOLYHEAD are proposed to be re-placed by wires crossing the Mersey.

LIVERPOOL AND HOLYHEAD.—At a recent meeting of the Mersey Dock Board (2nd December ult.), the Dock engineer (Mr. Hartley) reported the plan for constructing a line of Telegraph between Holyhead and Birkenhead. Tenders had been obtained for providing and laying cables for that portion of the line which will be submarine. There will be two distinct lines of wires the whole distance between Liverpool and Holyhead. The portion of submarine cable crossing the Mersey to be of as light a formation as it can be made, consistent with due strength and stability. A second light cable to be kept in hand, ready at a moment to be laid across the river, in the event of anything going wrong with the first. Consideration of report adjourned for a week. The chairman of the Marine Committee stated, that by the adoption of the electric line, £400 a year would be saved in the expenses for stations; and that with this amount, and the contributions which would be received from the underwriters, &c., £600 annually would be obtained to meet the costs of the new undertaking.

CAPE TOWN TO MAURITIUS.—The scheme for uniting the Cape with Mauritius, and by Mauritius and Ceylon with India and Europe, by Submarine Electric Telegraph, is, seriously entertained at both places. The distance from Mauritius to the Cape is 2,360 miles; but there are many ports in Africa much nearer, where the end of the first cable might be established, and from thence, by land or under water, extended to the Cape.

NEW TELEGRAPH COMPANIES.—In the notices, required by the standing order of the House of Commons, of intended applications for bills during the forthcoming session of 1859, there are two new (intended) Telegraph Companies announced; one to be incorporated for the accommodation of the London district—and the other for connecting India, Australia, and China.

CAPE HELLAS TO CONSTANTINOPLE.—According to the agreement with the Archipelago Company, the Turkish Government has to construct the land portion of this line, and this will be ready before the end of the present year (1858). The posts are (December) put up all along the line; and the vessel with the wire on board went down (from Constantinople) early in the same month; so that, by the beginning of 1859, the line from Candia will be open, offering some improvement in the telegraphic communication with India, the distance between Alexandria and Candia being only 420 miles.

TURKISH ARCHIPELAGO LINE.—The landing of the Submarine Cable from Candia to Syra and Scio, the successful accomplishment of which has been announced, is, it appears, still considered by the Turkish Government only as provisional, and the line as being allowed to exist under c rtain political and local conditions, to which the Archipelago Company will have to submit: the principal of which are—Only local messages to be transmitted to and from Greece, but no messages to be sent through Greece, coming from Alexandria and India; the office at Canea to be under the surveillance of a Turkish Government officer: in case of a collision between Greece and Turkey, the telegraphic communication with the Greek line shall be broken, and the cable submerged [query severed ?]. The Turkish Government pays a subvention of £4,500 a year for the telegraph from Cape Hellas to Alexandria; and is, consequently, anxious to insure the profits which will arise from the transmission of the Indian messages; hence the policy of the first condition: the second is to prevent opportunities for Greek intrigues in the Island of Candia—a precaution suggested by the recent outbreak there.

A LONDON DISTRICT TELEGRAPH COMPANY is to provide the various localities in the immediate neighbourhood of the metropolis with the means of telegraphic communication. The city and suburbs are to be divided into 11 districts, each containing 100 stations, so that a despatch may be delivered in any part in the course of a few minutes. Messages of 10 words to be sent for 4d. to any place within 4 miles of Charing Cross. The over-house system, as in Paris, New York, and Brussels, and, lately, in London by Messrs. Waterlow, to be adopted.

TELEGRAPH EXTENSION [FRANCE].—The French Government have it in contemplation to extend the advantage of telegraphic communication to all important towns in the neighbourhood of a railway. Telegraphic wires are to be carried from the point where the railway intersects the high-road to the chief town of the arrondissements. The preparations for carrying out this improvement, so important to the trading and manufacturing interests, are considerably advanced.

THE MERSEY DOCK AND HARBOUR BOARD decided (at a meeting held 8th December ult.) that a Telegraph Cable shall be laid between *Liverpool* and *Holyhead*; the Liverpool end of the cable crossing the Mersey at Woodside, to avoid the numerous anchorages and other impediments south of that point.

BOSTON (U.S.) AND HALIFAX (N.S.)—For connecting these points, a cable is to be submerged between Cape Ann and Yarmouth, Nova Scotia, a length of 200 miles. From Yarmouth to Halifax it is already, it appears, laid down. The cost of the new portion of the line is estimated at 150,000 dollars. The depth of water is said to be very moderate. The cable, according to the "Boston Transcript," is intended to be similar to that now laid from Cape Breton to Newfoundland, and is to have heavy shore-ends. There will be only one conducting wire, to be comprised of seven copper strands, covered with iron wire, as a metallic covering, answering for a short cable, though producing a retardation of the elastic current through a great length of wire.

FROM GALLE TO MADRAS.—The telegraph, through the Submarine Cable, across the Straits of Manaar, is now (advices from Calcutta to 9th November ult.) open to the public. A bit of the coast line between Madras and Calcutta is still imperfect, the bamboo posts, put up in extreme haste, and for a special purpose, having rotted away. The Overland

Mail of the 9th October was, however, signalled from Galle to Calcutta *viâ* Bombay in twenty-four hours.

From Kurrachee to Bombay the telegraph line is also complete, and there is not now an important city in India from which intelligence cannot be flashed to Calcutta in twelve hours. The charge for a message from Kurrachee to Bombay is two rupees (or about four shillings) for sixteen words.

A South Atlantic Telegraph is projected. The line to start from Falmouth, touch at Cape Finisterre, Lisbon, Cape St. Vincent (with a branch to Cadiz and Gibraltar), the Canaries (with a branch to Madeira), the Cape de Verde Islands, and the Islands St. Paul and Noronha, and arrive at or near Pernambuco, in the Brazils. A land telegraph to continue this line through the Brazilian territory as far as Para, whence a submarine line will be carried to the British settlement of Demerara, in Guiana. From here a combination of land and submarine wires will be constructed through the principal West Indian Islands to New Orleans, in the United States, where it will join the network of existing telegraphs belonging to the American companies.

Metropolitan and Continental [Junction].—The posts for the wires between the metropolis and the Submarine Cables, recently laid from the Norfolk and Suffolk coasts, follow the route of the old turnpike road from London to Norwich *viâ* Newmarket.

A New Submarine Telegraph Wire ("Roger's Deep-Sea Telegraph Cord") is being manufactured by a company at Baltimore, U.S. It is little more than a quarter of an inch in diameter, or one-third the size of the Atlantic Cable, and consists of a copper wire in the centre, about as large as a goodsize knitting-needle, covered first with a layer of gutta percha, and next with a braid of fine flax or hemp, thoroughly saturated with pitch. The peculiar feature of this cord for deep-sea telegraph purposes is stated to be that the wrapping is of such a nature that it will become heavy with deep-sea pressure, thus causing the wire to sink faster and faster the deeper it goes, on the principle that common lines of hemp, flax, &c., when subjected to deep-sea pressure, become specifically heavier than the water.

MARINE STEAM ENGINEERING, SHIPBUILDING, &c.

The "Great Eastern" has been bought by a new company for £160,000; the further fitting out will cost from £100,000 to £160,000. The only alteration to be made in her original design is in fitting her with a poop-deck, between 8 and 9 ft. high—the same height as the forecastle forward. The first year's trip will, it is stated, be to Portland, Canada; but the final line will be to and from India,—Trincomalee, as being central, and having a fine harbour, being selected as the Indian port. The cargo stowage is 8,000 tons; her stowage for coals about 12,000. Full steaming, her consumption of fuel will be about 200 tons per day; her average speed (as generally anticipated) from 17 to 18 knots an hour.

The "Topaze," 51, new screw steam-frigate, has been tried at Devonport. Steam was got up on board, and she was taken outside the Sound to test her new machinery at the measured mile. The run was satisfactory, averaging 12½ knots.

The "Dom Affonzo," large steamer, on her passage from the Clyde to Gibraltar, went down (23rd November ult.), in the Bay of Biscay; last sighted in lat. 47 N. long. 11 W., with her screw and rudder and bulwarks carried away, and pieces of machinery on deck. Crew saved by the *Henry Wylch*, and landed at Queenstown.

The "Vivid," mail packet, ran down in the channel (30th November ult., about 3 a.m.) the fishing lugger *St. Charles*, of Calais, while the crew were working their nets, 3 miles from the French coast; three perished, two saved by the *Vivid*. Cause of accident, the not showing a light in the boat.

Steamer Launches.—The new steam-ship *Nepaul*, built for the Peninsular and Oriental Steam Navigation Company, has been successfully launched from the yard of the Thames Shipbuilding Company, at Blackwall. Tonnage, 1,000; built from the designs of Mr. James Ash. To be propelled by engines of 200 H.P. by Messrs. Humphreys' and Tennant, of Deptford. Fitted with Robinson's patent ventilating panels. Rigged with Cunningham's reefing topsails.

The "Doris," 32 screw, went out from Devonport on her trial trip. Result satisfactory. Average speed 15 knots.

Steamer and Barque Collision in the Mersey.—The screw steamer *Senora*, from Liverpool for London, has recently come into collision, off the Rock Lighthouse, with the barque *Goodspeed*, from Mobile. The steamer struck the barque on the port bow, carrying away all her head gear, and stove in her bows. The steamer's fore compartment having filled, she was put on shore in the Sloyne, where the tide (1st December ult.) covered her at high water.

The "Indian Empire," lever line steam-ship, had, on her last homeward voyage, to suffer a severe trial of her sea-going qualities, owing to heavy south-easterly gales. When arrived at only 350 miles from Galway, having only thirty hours' coal remaining of the sixteen days' fuel with which she had started from Halifax on the 31st October, her captain deemed it advisable to lay to, which he did for seven days; during which time it was found necessary to consume, for fuel, a portion of the cargo, consisting of cotton, staves, &c.

The Atlantic Royal Mail Steam Company (Galway line) have given their first contract to Messrs. Palmer and Allport, steam-ship builders, of Newcastle-upon-Tyne, for three powerful "express steamers," which are promised to be "superior to any afloat," and to have a (guaranteed) minimum speed of 26 statute miles per hour.

The Niger Steamers.—Advices by African Mail from the steam-ship *Sunbeam*, attached to the Niger expedition, dated off Rabba, 6th October ult., state that the *Sunbeam* entered the Niger on the 30th June, reached Ebo on the 18th July, where she remained a month, and arrived at Rabba on the 2nd October, with the loss of only one European—the cabin steward. After embarking the collections of Dr. Baikie, R.N., she was to leave on her descent of the river, and may be expected to have arrived at Fernando Po in December. The *Rainbow* was daily expected at Rabba, having been heard of above the Brass, and the river having abundance of water.

Sunderland and Shields.—On the 1st December ult. there were 69 ships of various dimensions building at Sunderland: 19 are ready for launching, the remaining 50 will be ready for launching next year. The largest vessel is of 1,300 tons O.M., the remainder of from 1,100 tons to under 100 tons burthen. At Shields, there are only five vessels on the Stocks—viz., a barque of 447 tons, a ship of 642 tons, a brig of 252 tons, and one iron and one wood vessel not yet measured. During the past year (1858) only six vessels have been launched at Shields, with an aggregate tonnage of 2,577, including an iron lighter of 782 tons, built for the Thames.

The Peninsular and Oriental Steam Navigation Company are making a considerable addition to their fleet. Four new steamers—viz., the *Ceylon*, *Malta*, *Northam*, and *Salsette*, have recently been brought into active service, and six new names appear in their last list; namely, the *Emeu*, *Jeddo*, *Nepaul*, *Delta*, *Massilia*, and *Union*. The *Emeu* has been purchased from Mr. Cunard, deliverable at Sydney in February next. The *Jeddo* is building by Messrs. John Laird and Co., and the *Nepaul* by the Thames Shipbuilding Company. The *Delta* and *Massilia* are being constructed to receive the present powerful machinery of the *Vectis* and *Valetta*, and are intended to supply the places of the two latter, between Marseilles and Alexandria. The hulls of the *Vectis* and *Valetta* will be fitted with new engines of 260 H.P. The *Union* has been purchased for the mail service between Reunion and Mauritius, for which the Company have undertaken a contract with the French Government. The *Colombo* is being lengthened about 30 ft. amidships, the similar treatment of the *Candia* having been followed by excellent results. In addition, the Directors have just concluded the purchase of four screw-ships (not yet named in the lists), built by Messrs. John Laird and Co., at different dates, since 1855. At the date of their last report, read 4th December ult., their fleet consisted of 64 vessels, of all kinds (comprising 33 screw and 20 paddle); the total tonnage being 81,624, and total H. P. 18,615.

Harbours of Refuge (France).—A mixed Commission has been appointed by the Ministers of Marine and Public Works, to report on the important questions of Harbours of Refuge.

Austrian Steamers.—Austria has, at present, 108 ships of war, with 910 guns; three new steamers, whose names are to be *Francis Joseph*, *Narenta*, and *Kerkha*, will be built in 1859. The War-port of Pola will be completed by the year 1862, if nothing untoward should occur.

Fatal Tug-steamer Collision in the Clyde.—The tug-steamer *Glowworm*, belonging to the Glasgow Underwriter Association, was, recently, coming in the channel, about 2 miles outside the Cumbraes, and at the same time the tug-steamer *Champion*, belonging to the Greenock Towing Company, was going out, when they, by some mismanagement, ran direct into each other, and, almost immediately after, the *Champion* went down. The seven men on board at the time got all on the deck, and contrived to get out the steamer's boat; but the boat being small, capsized, and they were left struggling in the sea. Meantime the *Glowworm* had put round, and sent her boat in search of the drowning men, but only three were picked up.

The Sunderland Life-boat.—This splendid gift, lately presented to this port by Miss Burdett Coutts, has been placed, with suitable honors—a numerous procession of the Monkwearmouth Colliery Band, seamen of the port, &c.—in the house which has just been built for it, by subscription, at the South Dock, situate to the east of the North Tidal Basin. The Life-boat house, the materials for which were given by the Commissioners of the River Wear, has been so built that the upper parts can be made into a "look-out," and it is to be used for that purpose. The Life-boat (called the *Duke of Wellington*), on its carriage, decorated with flags, was drawn to its destination by four fine grey horses, and installed by the mayor, who delivered an appropriate address on the occasion.

Cape of Good Hope Life-boats.—The trial of two Life-boats, ordered some time since by the Cape Government to be built in this country by Messrs. Forrests (38 ft. and 32 ft. long, respectively), took place (26th November ult.), in the Regent's Canal Dock. The 38 ft. boat was turned over by means of some tackling attached to a hydraulic crane. After being turned "keel up," she at once recovered her proper position, and freed herself of the water she thus shipped, in less than 30 seconds. Stability of the boat such, that it required the weight of thirty-three men on one gunwale to bring it to the water's edge. The new boats are to be permanently stationed, respectively, at Table-Bay and Port Elizabeth.

MILITARY ENGINEERING, &c.

"Proving" Guns.—Some of the guns which have been lately turned out from the new iron-gun foundry in Woolwich Arsenal, appearing (notwithstanding the somewhat unfavourable results of the proving-ground generally) to possess every desirable quality for service, are ordered to be subject to the ordeal of being fired with increased charges of powder and shot until they burst, in order to carry out the "standard" character of the new establishment. To provide however against the risk of accident, the Secretary for War, at the suggestion of the local authorities, has ordered the formation of a bomb-proof compartment within the huge mound of earth recently erected as the proof-butt for carrying out the project.

The Proof-Cave—Lowmoor Guns.—When, some time since, experiments similar to those above alluded to were instituted by the late Colonel Dundas, for testing the Lowmoor guns, some of them withstood upwards of 1,000 charges, without evincing any marks of damage.

Engineers and Artillery (India).—It is generally understood, that it has been resolved in the Council of India that all appointments to the Engineers and Artillery shall be (for the future) thrown open absolutely to public competition, and that no nomination will be required.

Coast Defences.—The War-office authorities are in treaty with the Town-council of Hartlepool for a lease of two portions of corporation ground on which to erect powerful batteries for the defence of this part of the coast. The corporation have agreed to grant a lease of the sites, at a merely nominal rent, for 31 years. One of the sites is a little northward of the Hough Lighthouse, being a portion of the Town-moor, and comprising an area of about 7,498 square yards; the other site is in the Farwell-field, about three-quarters of a mile further north, and containing 2,363 square yards.

Timber for the Ordnance.—From the evidence before the Weedon Commissioners, it appears that the cost of wood supplied to the Ordnance Department amounts to little less than £50,000 a year for gun-carriages, train-waggons, &c.

A Fatal Gunnery Accident occurred (25th November ult.) at Vincennes: General Ardant, of the Engineers, who was assisting at a trial of guns being fired at a target, was struck on the head by a projectile, and was killed on the spot. The Minister of War, Marshal Vaillant, was standing near him at the moment, but escaped unhurt.

The New State Arsenal at New York has been destroyed, the roof having fallen, carrying with it the upper story of the northern, eastern, and southern walls. The building was 82 ft. by 184 ft. in the clear, with a turret at each corner, one of them, the highest, being 120 ft. in height. A joint of one of the main rafters is understood to have given way, letting the roof fall upon the lower girders which rested upon the walls, which were, in consequence, forced out. No person was killed. The fall took place during the night.

HYDRAULIC ENGINEERING, &c.

Pumping-stations for the New Drainage.—At the recent meeting (26th November ult.) of the Metropolitan Board of Works, it was referred to the Main Drainage Committee to take the necessary steps for obtaining the houses and land requisite for the construction of the pumping-station at Deptford Creek, with power to engage such professional assistance as might be necessary for the purpose.

Cornish Pumping-engines.—The number of pumping-engines reported to the 23rd November, 1858, is 16. They have consumed 982 tons of coal, and lifted 7,400,000 tons of water 10 fathoms high. The average duty of the whole is, therefore, 51,000,000 lbs. lifted 1 ft. high, by the consumption of 112 lbs. of coal.

An Irrigating Hydraulic Engine of enormous power has just been finished by Messrs. Abernethy, at their works at Ferry-hill, Aberdeen. It is intended for an East India Plantation, and its object is to pump water for purposes of irrigation, on both sides of a hill 500 ft. in height. It consists of 12 pumps, which act in sets; and it will be driven by a water-wheel of 200 horse-power. The engine is calculated to lift water at the rate of 1,000 gallons a minute.

The Marine Wrecking Pump.—The wrecked screw steamer *Genova*, which came recently into collision with the ship *Goodspeed*, and sank at the entrance of the Mersey, was (6th December ult.) cleared of water by the application of Palmer's "Marine Wrecking

Pump," and is now (8th December) ready for discharge. This "Wrecking Pump," an American invention, works upon the atmospheric principle; about 68 tons per minute issued from the discharge-pipe; and in 16½ minutes, the vessel was completely clear of water, though, previously, she had 18 ft. 6 in. in her hold.

SEWERAGE ENGINES.—Amongst the various proposals now before the Board of Works for draining the Metropolitan Sewerage is one from Mr. Guillaume of Southampton, respecting the use of his hydraulic lever for that purpose. His letter was read by Mr. Bazalgette, the engineer, at a recent meeting of the Board.

WATER SUPPLY—(METROPOLITAN AND PROVINCIAL).

METROPOLITAN DRINKING-FOUNTAINS, LAVATORIES, &C., &C.—A plan (submitted by Mr. Jennings, sanitary engineer) is at present under consideration of the City Commission of Sewers, for providing public drinking-fountains, lavatories, water-closets, and urinals, in proper situations throughout the City. Upon a site of 10 ft. in diameter, it is proposed to erect drinking-fountains above ground, with urinals and water-closets beneath, all properly lighted and ventilated; the attendants to be permitted to accept small gratuities from the visitors to the places. All this the proposer offers to carry out (in the first instance) at his own expense; but, in the event of these places becoming remunerative, he will make them over to the commissioners, provided they will undertake to furnish proper paid attendants. The proposal was (14th December ult.) referred to the General Purposes Committee, to report upon.

ANALYSIS OF THE METROPOLITAN WATER COMPANIES' SUPPLY DURING NOVEMBER, 1858.—In the Registrar-General's Report, the following analysis (by Dr. R. Dundas Thomson, F.R.S., of St. Thomas's Hospital) is given. The amount of impurity in each water will be found to increase as the winter advances, depending on the rain, which brings down the soluble matter from the agricultural grounds into the river:—

	Total Impurity. Grs. or deg.	Organic Impurity. Grs. or deg.
Distilled water	0·0	0·0
Loch Katrine, new supply to Glasgow (given for sake of Comparison)	2·14	0·8
Well, Newman-street, Oxford-street (ditto)	126·32	12·96
Thames Companies:—		
Lambeth	18·24	1·52
Grand Junction	19·20	1·48
West Middlesex	18·32	1·32
Southwark	18·28	1·36
Chelsea	17·72	1·72
Other Companies:—		
East London	21·32	1·40
Kent	19·32	1·88
New River	19·16	1·32

The Table is read thus: Loch Katrine water contains in the gallon 2·14 degrees or grains of foreign matter in solution, of which 0·8 degrees or grains are of vegetable or animal origin.

WATER SUPPLY TO THE CRYSTAL PALACE.—At the half-yearly meeting (15th December ult.), the Chairman, amongst other topics of increased expenditure, entered into details of that arising from "increased water-supply, rendered necessary," not, as we might naturally have expected, from the great fountains, &c., but "in consequence of the enlargement of the refreshment department."

GAS ENGINEERING—(HOME AND FOREIGN).

GAS IN STEAMBOATS.—The "New York Times" of the 9th November ult., announces that gas was introduced on the Fulton Ferry-boats the preceding evening. The *Nassau* was the first boat lighted, and the effect was good. The gas is obtained from the works of the Brooklyn Gas-light Company, at the same price as charged to private consumers. A hose is attached to the docks, to introduce the gas into receptacles prepared for the purpose on the decks of the boats. Thence it is conducted to the engine-rooms, and distributed into the cabins. The cylinder in the hold is 14 ft. long by 4 in. diameter, lined with galvanised iron. The pressure of the gas is one half-pound to the inch.

CONSTANTINOPLE LIGHTED WITH GAS.—Amongst other European improvements, the recent introduction of which is rapidly metamorphosing the ancient metropolis of the East, may be mentioned, the fact, lately announced in the "Gazette du Midi," that gas is being laid down, by order of the Municipal Council, in the streets of Istamboul, which are described as being, hitherto, almost impassable, "particularly after dark."

THE PUBLIC LIGHTING (BY GAS) OF THE METROPOLIS is stated, on we believe competent authority, to cost not less than £240,000 a year, and it is openly stated that an overcharge is now made, by the Gas Companies, of not less than £60,000 a year on the public lighting alone,—that is, at their own prices, and according to the quantities they profess to supply at those prices.

ATHENS has been lighted with gas.

AN EXPLOSION OF GAS, by which three persons were severely burnt and otherwise injured, occurred recently at the Bush inn, in Oakwell Gate, Gateshead. About 4 o'clock in the afternoon, a strong smell of gas was perceptible, proceeding from a sitting-room upstairs, into which the gas is laid in connection with a chandelier suspended from the ceiling. To ascertain the place of escape, the landlord incautiously applied a lighted candle, when the gas suddenly ignited, and produced an explosion which blew out the whole of the windows in that part of the house, and shattered the furniture. The landlord, his wife, and a servant-maid (the two latter having joined him to assist in tracing the escape) were all knocked down by the force of the explosion, and seriously burnt, the landlady so much so as to require removal to the town infirmary. The unusual violence of the explosion is thus explained. On examination by a gas-man, it was found that the gas had been escaping from an old and damaged pipe: and, having been escaping for some time, had formed an accumulation about the ceiling, and on the lighted candle being raised towards the top of the room, the serious effects above noted had occurred.

A TOWN IN DARKNESS.—Under this heading, the "Northern Daily Express," of the 7th December ult., makes the following curious announcement:—"Redcar. The supply of gas for the street lamps has been stopped, owing to the gas accounts not having been paid: and there the cast-iron columns stand, showing the financial depression of the place. We, however, understand that it is the ratepayers' intention to have the greater portion, if not all, re-lighted again."

A GASOMETER FOR ROME.—A small gasometer arrived, recently in Cardiff, by the South Wales Railway, in two parts, and was (7th December ult.) taken down to the docks, to be shipped for Rome.

THE LARGE GAS-HOLDER AT THE IMPERIAL GAS COMPANY'S WORKS, BETHNAL GREEN.—The tank is of brick and iron work, measuring 204 ft. in diameter, and 41½ ft. deep, having a clear working depth of 40 ft., and requiring 6,000,000 gallons of water to fill it. The gas-holder is of the telescopic kind, and consists of two cylinders, sliding one within the other. Dimensions—Outer cylinder, 201 ft. in diameter; depth, 40 ft.; inner cylinder (with a dome-shaped roof, rising 8½ ft.), 198½ ft. diameter, and 40 ft. deep. United capacity of the two cylinders, or whole gasholder, 2,500,000 cubic ft. Amount of iron employed in the whole structure (including frame-guides, &c.), 1,500 tons.

A NEW MATERIAL FOR MAKING GAS, and called "illuminating clay," has been discovered at Rio Janeiro. It is stated to have given 7 cubic ft. of gas to the pound; while coal gives only 3½ cubic ft. It is the colour of clay, and resembles coal in its pure state. It is said to burn like wax when held in contact with flame.

AN EXPLOSION OF GAS occurred, after midnight (20th December ult.), at a dwelling-house in the Euston-road. In the drawing-room was what is technically termed a "hydraulic telescopic chandelier burner." The room not being lately in use, the water had not been replenished; and the valve-stop being left open, the gas continued to escape during the whole of the afternoon and evening, whilst the other lights on the premises were burning. Upon perceiving the smell of gas, the attention of a maid-servant was called by her mistress to the fact; the former assured her mistress that the gas was turned off at the main: but she, incautiously, entered the drawing-room, lighted candle in hand. The room was, at once, in a blaze; and nearly every pane of glass in the house was shattered to atoms with an alarming explosion: two heavy iron-framed skylights were literally lifted from their supports; and panels of half an inch in thickness blown out of the doors. The servant sustained such injuries as to render necessary her removal to the hospital.

HARBOURS, DOCKS, CANALS, &c.

THE NEW GRAVING-DOCKS in connection with the Victoria Docks (commenced about two years back) have been completed. By means of a new hydraulic lift, and a contrivance for subsequently floating each vessel into shallow water (on the patented method of Mr. Edwin Clark), where all the necessary examinations and repairs can be conducted from workshops alongside, the excessive cost of the excavations necessary under the old system are entirely avoided. The first experiment was tried upon an iron-vessel of 600 tons, which was raised to its required position in 35 minutes. The outlay on the works has been £116,000, furnished by a few engineers and capitalists, associated as a company, under the Limited Liability Act.

THE MERSEY DOCK AND HARBOUR BOARD have (9th December ult.), agreed to erect cranes on the Canada Dock, Birkenhead, for the accommodation of the timber trade.

THE NEW "WESTERN DOCKS" AT SWANSEA are in active progress. These magnificent works comprise buildings, &c., of very considerable extent, embracing a capacious trumpet-mouth entrance, a half-tide basin, a gigantic lock, an iron bridge, and an inner dock of sufficient area to afford room for some hundreds of ships. At present 500 men and 50 horses are employed in these works (the excavations are about three-fourth parts done)—and next August is named for the inauguration.

FECAMP [COAST OF NORMANDY] DOCKS, &c.—An imperial decree (receipt of copy of which is recently announced in the "London Gazette")—authorises the establishment of bonded warehouses, &c., at this port.

THE NEW RUSSIAN DOCK-YARD WORKS AT VILLAFRANCA.—A Government French engineer has been placed at the disposal of Archduke Constantine, for the naval and dock-yard works about to be constructed at this Russian Port in the Mediterranean.

BRIDGES.

RHONE SUSPENSION BRIDGE.—The left bay of the suspension bridge over the Rhone, at Powzin, has been carried away, at mid-day, by a gust of wind; it was nearly 100 metres span. The two other bays have not suffered, nor were the telegraph wires broken. The flooring of the bridge being under water, all communication was for a time intercepted between Drome and Ardeche, at a point much frequented, owing to the neighbouring forges and the Lorial and Aveyron Railway Stations.

THE VAR (SARDINIAN SIDE).—At half-past three o'clock, on the 27th November ult., immediately after the passing of an omnibus, two arches of the bridge over the Var, on the Sardinian side, were carried away by the flood. The communication between Piedmont and France was consequently interrupted.

THE NEW SWING-BRIDGE AT PORT ADELAIDE, SOUTH AUSTRALIA, connecting the South-Australian Companies and Levi's Wharfs, by spanning the entrance to the new dock of the former, was opened July 19th ult. The structure is a double-winged swing or pivot-bridge, spanning an opening of 40 ft., constructed of cast and wrought iron, with longitudinal principal beams and truss-pieces of timber. The bridge has a carriage and footway of 17 ft. in width, over which runs a line of rails connected with the railway station. The waterway is 40 ft. in the clear. The timber used in the piers is from Swan River, a wood known to withstand the worm and other destructive influences. The weight of each leaf, without the roading, is about 30 tons; each abutment or pier contains, besides the timber piles, &c., nearly 100 cubic yards of stone filling. The strength of the bridge was tested by a weight of 50 tons, being placed on it simultaneously with the tramping of upwards of 40 men, and the deflection this produced was exceedingly small.

THE "VICTORIA" BRIDGE AT MONTREAL (contractors, Messrs. Peto, Brassey, and Bett), has made such progress, that it is expected to be opened for traffic in October, 1859. The Grand Trunk Railway system, as soon as this link is completed, will consist of a continuous line of nearly 1,200 miles between Chicago, the emporium of the West, and the Atlantic Seaboard at Quebec and Portland. According to the "Canadian News," the setting of the stonework on this structure has, for some time past, averaged upwards of 80,000 cubic ft. per week. Ten out of the twenty-four tubes are fixed, and it is expected that two more will be finished by the end of December ult. Five more were expected to be completed by April next, leaving seven to erect during the six ensuing months. Twenty out of the twenty-four piers were ready for receiving the tubes.

THE SARAMA (SPAIN).—A sad accident, says the Madrid journals (of the 3rd December ult.), has taken place in the village of Arganda. The bridge, which passes over the Sarama, broke down, precipitating into the swollen waters two men who were driving four heavily-laden mules. The latter were carried away by the torrent, but the men were saved (though seriously injured) by some of the inhabitants of the village.

THE BRIDGE OF "LA REINA," on the road to Gallicea, has also been carried away by the floods, so that communication with Corunna is interrupted.

IN BEJER (OLD CASTILLE), a portion of the quay fell (same date) into the river, and, carried by the rapidity of the current against the bridge, broke it down. The fragments were urged with prodigious force against some neighbouring mills, and did a great deal of damage.

THE DEEPDALE VIADUCT, on the South Durham and Lancashire line, is fast approaching completion. The last girder has just been placed in its position, the event being greeted with suitable demonstrations.

THE NEW WESTMINSTER BRIDGE AND SIR CHARLES BARRY.—As to his reported share in the plan of the new bridge, Sir Charles, in a recent letter to the "Times," states that "although the universal and remarkable characteristics of the superstructure, such as its spacious width, the lowness and easy gradients of its roadway, the proportions of the piers to the arches, and the curve and headway of the latter, are in accordance with his design, as adopted by the late Sir William Molesworth; the elevation now proposed to be carried into effect is so much at variance with that design as to absolve him (Sir Charles) from all responsibility in respect of the questionable taste of its details. As to the bridge being in harmony with the style of the New Palace at Westminster, he has to observe that the elevation now proposed does not comply with that condition:" and he adds, that he does not consider such accordance to be necessary, even if it were practicable.

ACCIDENTS FROM MACHINERY.

STEAM SAW MILL.—On the 18th November ult., a man, apparently a stranger, entered the saw mills of Mr. Fears, at Bristol. The only persons in the mill at the time were two of the workmen, and the driving of the mill had begun. It was a steam saw mill, of enormous power, working with great rapidity. The visitor walked along by the side of the wall for some distance, and then ventured very near the saw, in front of the engine. His foot slipped, and he fell forward; as he fell the saw entered his head, and before the machinery could be stopped the man was dead. His skull was completely severed to the neck and shoulder.

Vats—Suffocation by Carbonic Acid Gas.—At the brewery of Mr. Thomas Howard, Cheapside, Liverpool (21st Nov. ult.), two men having entered the "working round," or large tube, for the purpose of cleaning it out, preparatory to another brewing, before the usual precaution had been taken of clearing it of the carbonic acid gas generated by the fermentation of the previous charge of liquor; both commenced sweeping with brooms, when in a few minutes they became overpowered with gas, and fell prostrate at the bottom of the "round." They were taken out dead.

Oat Crushing.—At Nottingham, at the Midland Company's warehouse, a fearful accident occurred (25th November ult.). A man was engaged crushing oats, by machinery. In consequence of a noise being heard, his fellow-workmen on the premises entered the room, where they found the body of the unfortunate man literally torn limb from limb, his skull fractured, the bones scattered about, the left leg torn from the body, and his ribs lying about the place in shreds. It is supposed he was putting the shafting-band round the drum, and that his clothes became caught by the machinery, his head being forced to the ceiling, and his body whirled round by the wheel. At the inquest, held in the afternoon, a verdict of "Accidental Death" was returned.

Fatal Railway Accident at Warrington.—A horse-driver has died from the injuries he received at the Bank Quay Railway Station. The deceased was walking by the coke benches, where there was an engine with a brake-van attached standing at the time. The fireman, who was the only person on the engine, whistled, and drove the engine towards the deceased; but before he could get out of the way, the brake-van caught him on the abdomen, crushing him between the coke benches, and rolling him from one end of them to the other. He lingered till the 25th November ult. Verdict, "Accidental Death."

Swinging a Flag-stone.—At Liverpool, before the Borough Coroner, an inquest was held (27th November ult.) on a carter, named Richard Martin, aged 40. The deceased was assisting to swing a large flag-stone from a railway waggon, in the station of the Lancashire and Yorkshire Company, when the chain broke, and the stone which was 2½ tons weight fell upon him, crushing both legs in a shocking manner. He only survived amputation of both limbs for three days. Verdict—"Accidental death."

An Inquest was held (10th December ult.) at Erith, on the body of Henry Ayres, a stoker at the factory of Mr. Young. On the 6th December, the deceased was attending to a steam-engine on the premises; whilst thus engaged, he, as it is supposed, fell forward, and was caught by the fly-wheel of the engine, revolving at great rapidity in a pit about 6 ft. deep. When found by a labourer, the machinery was stopped, and the lifeless body of the deceased was brought out, the head being completely crushed. It further appeared that the fly-wheel pit was wholly unguarded; and the jury, in returning a verdict of "Accidental Death" added that precaution ought to be used to prevent a like occurrence. The manager of the works, who was present, promised that the suggestion of the jury should be attended to.

MINES, METALLURGY, &c.

The Yorkshire Colliers' Strike, which has now existed for upwards of nine months, originating in serious differences between the colliers and their employers, as to wages, time, &c., still continues with, apparently, but slight prospects of adjustment.

The late Colliery Inundation near Llanelly, Carmarthenshire.—After a lapse of nearly three weeks, eight of the bodies of the ten men who lost their lives (on the 27th October ult.) by the sudden irruption of the Cae Colliery, have been (close of November ult.) recovered. At the Coroner's Inquest, the jury returned a verdict of "accidental death, caused by the ignorance of Daniel Francis, one of the deceased, in not using the precautionary measures of boring, and not keeping plans of the workings of the colliery."

Fatal Accident from "Blasting."—A miner, engaged at Messrs. Dixon's limestone pits, Dudley Port, blasting the rock for the purpose of moving the stone, was (1st December ult.), by accident or incaution, literally blown to pieces. In firing one of the charges (gunpowder) he had no opportunity of retiring before the explosion occurred. Blown a considerable distance from the spot on which he was at work, he presented on being taken up, a horrible appearance. He lingered, however, in this awfully mutilated condition, until the following Saturday—three days. On the inquest, a verdict of "accidental death" was returned.

The Serf-Miners in the Ural.—From St. Petersburg, we learn that the Emperor has lately ordered that the serfs belonging to the mines (placed under the direction of the Minister of Finance), shall be emancipated within the delay of six months. The persons employed in these mines (District of the Oural) were originally free. Peter the Great, wishing to give an impetus to metallurgical industry in Russia, conceded to all who would devote themselves to that branch of industry, whether nobles or tradesmen, whole villages as well as forests, whence they could procure all the wood they might require. The rights of those new proprietors over the peasants who inhabited the villages, were at first limited, but, by degrees, the nobles encroached on these privileges, and at length the peasants became real serfs.

An Extraordinary "Blast" of Granite was effected (24th November last) at Foggintor Granite Quarries, Dartmoor. A mass of granite, of first-rate quality, measuring 45 ft. in length, 26 ft. wide, 14 ft. thick stone, 1,000 tons in weight, was broken from its natural position by the small quantity of 10 lbs. of gunpowder.

New Gold Fields in the Brazils.—The recent discovery of gold in the Argentine Province of San Luis,—advices from the River Plate, by the Brazil Mail—confirm the first account that gold is found in abundance in Canada Honda. Diggers or washers were collecting their two or three to thirty ounces a day, and great numbers of people were flocking in that direction. The Government of San Luis were encouraging the gold-mania, by releasing persons engaged in its collection from military service. San Luis is between 600 and 700 miles from Buenos Ayres, in a west-north-west direction, and hitherto reckoned as one of the most wretched of the petty governments in the interior.

A Gloucestershire Coal-Mining Company (Limited) propose to open works near the village of Ruar Dean, in the Forest of Dean. The purchase-money for the property is to be £30,000, to be paid partly in cash and partly in shares.

A Fatal Colliery Explosion, attended with the loss of more than twenty-five lives, took place, at noon of the 11th December ult., at Tyldesley Colliery, 2 miles from Leigh; owners, Messrs. Green, Holland and Co. The fire-damp exploded in a down-brow, running south, and then taking a rectangular direction, and extending to beneath St. George's Church, Tyldesley. Most of the colliers and drawers who were at work in the different bays, and in the levels, were killed. With one exception, the deceased seem to have been suffocated by the "after," or choke-damp, which would encompass them immediately after the explosion. One of the bodies were found blown to pieces. Cause unknown, but conjectured to have been the bursting of the gauzework of a safety-lamp, and the consequent explosion of a naked light. The catastrophe, according to the "Manchester Guardian," was not altogether unexpected, from the known foul state of the workings for the last three years.

Colliery Explosion at Swansea, North Wales.—Four Lives Lost.—At the Morfa Colliery, Taiback, near Port Talbot, midnight, on the 25th November ult., an explosion occurred in a level, known as "the West-level Cribbor Vein." The "fire" did not extend beyond the immediate locality. Caused (as it is supposed) by a workman (one of the sufferers) incautiously removing the top of his safety-lamp.

APPLIED CHEMISTRY, &c.

"Acierage" of Engraved Copper-plates.—M. F. Faubert, at a recent meeting of the Society of Arts, explained his method of rendering engraved copper-plates capable of producing a greatly-increased number of impressions. The chief object was to harden the surface of the plate, and protect it from wear while printing. This desideratum he accomplished by covering the printing-surface, whether in intaglio or relief, and whether of copper (ordinary or electrotyped) or other soft metal, with a very thin and uniform coating, or film of iron, by means of a series of electro-metallurgical processes, which he described. His invention, he stated to be applicable whether the device to be printed from be produced by hand-engraving, or engraving by machinery, or by chemical means, and whether the surface printed from be an original or an electrotyped copy. On the old method, steel-plates, engraved in intaglio, would yield about 3,000 impressions without re-touching; copper, about 800; electro-casts of copper, only about 200: whereas, by the present process, one electro copper-plate, having yielded more than 12,000 impressions, was found, when examined minutely, to be quite unimpaired. Plates, moreover, showing any sign of wear, may be again coated, and the printing renewed. They acquire, in fact, more than the durability of steel.

Boron, a Substitute for Diamond-Powder.—M. St. Claire-Deville, of the Paris Academy of Sciences, has, in co-operation with M. Wöhler, experimented upon boron; and the results are among the most remarkable of the recent chemical inquiries. Boron is a substance hitherto classed between silicon and carbon, but with this anomaly, that it was not crystallisable as these two are. But the researches in question prove it to be producible under three polymorphic forms, and crystallisable. Specimens were laid before the Academy of various colours; from honey-yellow to garnet-red; the crystals, in some instances, being perfectly limpid and transparent. One kind, distinguished as "Adamantine Boron," is formed by a combination of aluminum with boric acid, and possesses most remarkable properties. It is *harder than diamond*. Boron-powder will cut and drill rubies, and even the diamond itself, with more facility than the diamond-powder.

A New Bronzing Process [for Brass] has been introduced by M. R. Wagner. To obtain brass of a very deep black color, he moistens the metal with a dilute solution of "azotate of protoxide of mèrcury," and he changes the film of mercury thus formed on the surface of the article into the black sulphuret of mercury, by washing it repeatedly with a solution of sulphuret of potassium. If for the solution of the liver of sulphur, we substitute a solution of liver of antimony or of arsenic, a fine brass-colored bronze ("un beau bronze de laiton") is obtained, varying in color from a deep brown to yellow-brown. He prepares the sulphurets of antimony or of arsenic, by boiling kermes (for the former), or orpiment (for the latter) in a solution of liver of sulphur.

Gilding Thread for Weaving Cloth of Gold, &c.—Hitherto no other method has been known of producing "cloth of gold" in the loom, than using metallic threads, which render the tissues stiff and heavy. By the process recently invented by the Messrs. Burot these objections are avoided. The silken, or other threads, are stretched close together, and are then dipped into a solution of azotate (nitrate) of silver, to which ammonia is added, until the solution be perfectly limpid. After immersion for one or two hours, the threads are dried (?), and then submitted to the action of a current of pure hydrogen. The threads becoming thus metallised, become also good conductors of electricity, and are then gilt by any of the ordinary methods in use for electro-gilding.

LIST OF NEW PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 31st July, 1858.

1740. C. de Bergue, Dowgate-hill, London — Submarine telegraph cables, and machinery for laying down the same.

Dated 30th August, 1858.

1956. F. Brignoles, 58, Torrington-square—Apparatus for the disinfection and rectification of bad-tasted alcohols, by the separation of the essential oils from the alcoholic exhalations.

Dated 17th September, 1858.

2102. C. Hadley, Lower Hurst-street, Birmingham—Improvement in omnibuses, cabs, railway carriages, waggons, and other similar vehicles.

Dated 27th September, 1858.

2172. G. T. Bousfield, Loughborough-park, Brixton—Manufacture of paper bags and other similar articles.

Dated 29th September, 1858.

2182. E. L. Benzon, Sheffield—Manufacture of steel.

Dated 1st October, 1858.

2190. T. Preston, Nottingham—Manufacture of looped fabrics.

Dated 8th October, 1858.

2236. E. V. Rippingille, Chorlton-upon-Medlock, Greenheys, Manchester—Fire-arms and artillery.

Dated 20th October, 1858.

2342. P. C. Stortz, Havelock-buildings, Bold-street, Liverpool—Materials of photographic plates.

Dated 21st October, 1858.

2350. C. W. Williams and G. Eyton, Liverpool—Construction of locomotive and other steam boilers.

Dated 27th October, 1858.

2394. L. Wray, 5, Devonshire-street, Portland-place—Application of a substitute for gutta percha, caoutchouc, and similar substances.

Dated 1st November, 1858.

2430. C. Vero and J. Everitt, Atherstone, Warwickshire—Manufacture of hats and other coverings for the head.

2432. J. Dobson and D. Pearce, St. James-street—Manufacture of bird-cages.

2434. E. Maynard, Brooklyn, New York, U.S.—Submarine telegraph cables.

2436. W. Palmer, New York, U. S.—Fire-arms.

Dated 2nd November, 1858.

2437. L. Beaver, Manchester, Lancashire—Sleeve-links.

2439. M. A. F. Mennons, Rue de l'Echiquier, Paris—Improved combination for the production of voltaic electricity.

2440. D. Tomasini, Store-street, Bedford-square — Respirators.

2441. N. Brough, Birmingham—Certain improvements in buttons, and in the means of attaching them to garments.

2442. R. C. Smith, Birmingham—A new or improved buoy or wreck intelligencer.

2452. J. Lancaster, Belfast, Antrim—Method of driving and curbing horses.

2444. M. L. J. Lavater, Strand—Cartridges for military and other purposes.

2445. A. Barclay, Kilmarnock, Ayr, N.B. — Electric and magnetic, or electro-magnetic telegraphs.

2446. D. D. Kyle, Albany-street, Regent's-park—Boots and shoes.
2447. J. Sampson, J. Machon, and J. Bartholomew, Sheffield—Railway carriage brakes.
2448. A. McDougall, Manchester — Construction of reservoirs, tanks, culverts, seawalls, and other erections required to exclude water or damp.
2449. N. S. Dodge, St. Paul's-churchyard—Treating waste vulcanised india-rubber.

Dated 3rd November, 1858.

2450. S. Bottomley, Bradford — Manufacture of moreens, and other fabrics of a similar character.
2451. C. F. O. Glassford, Greenwich — Manufacture of manure from the excreta of towns.
2452. H. T. Moret, 1b, Welbeck-street, Cavendish-square—The application of a mineral, named Deterso, as a disinfecting, preserving, absorbing, and curative, powder.
2454. J. Tall, Collingwood-street, Blackfriars-road—Brushes or brooms for sweeping floors, carpets, and other similar articles.
2455. V. Blumberg, Bloomfield-lodge, Notting-hill—Construction of slate billiard tables.
2455. D. Fryer, T. L. C. Watt, and W. Holmes, Paternoster-row—Tanning hides and skins.
2456. P. A. Mawdsley, Seacombe—Apparatus for drying yarns after being sized or stiffened.
2457. P. A. Mawdsley, Seacombe, Cheshire—Application of certain substances in the manufacture of paper.
2458. J. Fowler, jun., R. Burton, and D. Greig, Cornhill—Applying motive power to actuate ploughs and other agricultural implements.
2459. F. P. Busse, Carlton-terrace, Sydenham-park, Kent—Breech-loading fire-arms.

Dated 4th November, 1858.

2460. E. Fielding, Todmorden, Lancashire—Method of preserving the form of cops of yarn by the application of adhesive substances.
2461. J. Oxley, Camden-town—Carriages and wheel vehicles.
2462. C. F. Vasserot, Essex-street, Strand — Driving machinery applicable for thrashing grain and other agricultural purposes.
2463. G. A. Evelyn, Eccleston-terrace—The improvement of the form of the stocks of rifles, carabines, and other fire-arms.
2464. J. R. Napier, Glasgow—Obtaining motive power by means of heat.
2465. C. Mather, Salford, Lancashire—Drying yarns.
2466. W. T. Mabley, Manchester — Printing and dyeing woven fabrics.
2467. R. A. Brooman, Fleet-street, London — Treating air and gases.
2468. I. Baggs, Kennington—Telegraphing by electricity.
2469. A. Friedmann, Frankfort-on-the-Maine — Bracelets, necklets, and rings.

Dated 5th November, 1858.

2470. W. H. Tooth, Lampeter-street, Islington—Manufacture and construction of fire or furnace bars.
2471. T. Till, Hooper-street, Birmingham—Machinery for making nails.
2472. T. B. Smith, Marietta, U.S.—Preparing wood, so as to be used as a substitute for curled hair, in the manufacture of mattresses.
2473. C. J. Tjador, Stockholm, Sweden—Gun carriages, and apparatus for lessening recoil.
2474. E. Rowland and J. Dewhurst, Manchester—Certain improvements in steam-engines, and in the valves connected therewith.
2475. D. McClure, Heaton Norris, Lancashire—Machinery used for the drying of yarn, thread, cloth, or other wet fabrics.
2476. C. Mills, 8, High-street, Camden-town—Action of pianofortes.
2477. L. Schwartzkorf and F. C. Phillipson, Berlin—Machinery for boring holes in rocks and minerals, for blasting and other similar purposes.
2478. S. Davey, Rouen, France—Blasting powder.
2479. R. E. Pinhey, Woolstan, and J. Wood, High-street, Southampton — Apparatus for ascertaining the variation of ships' compasses for local errors.

Dated 6th November, 1858.

2481. H. N. Penrice, Witton-house, near Norwich—Machinery for tunnelling and driving galleries through rock and other strata.
2483. B. W. Jonas and R. Jones, Southwark, Surrey—Ship's block.
2483. A. Fryer, Manchester—An improved method of supplying the tenders of locomotive engines, and of supplying boilers with water.
2484. W. Green, 21, King William-street, Strand—An improved harness trace coupling.
2485. J. Cliff, Lambeth, Surrey—Construction of kilns for burning stoneware, red-clay ware, and all other kinds of earthenware.
2486. Baron D. Webster, Penns, Warwickshire, and J. Horsfall, Birmingham—Manufacture of steel wire.
2487. W. Ziernogel, Hettstadt, near Eisleben, Prussia—Apparatus for distilling products from bituminous coal, schist, peat, and other like substances.
2488. M. Matley, H. Miller, and T. Hall, Ashton-under-Lyne—Improvement in the construction and arrangement of steam-boilers and furnaces, for the purpose of consuming smoke, economizing fuel, and beating the feed-water, and also improvements in certain valves connected with steam boilers.
2489. J. Jackson, A. Fisher, and J. J. Harney, Sheffield—Manufacture of strips or bands of steel.
2490. J. Platt, Oldham—Apparatus for preparing, spinning, and doubling cotton and other fibrous materials.

Dated 8th November, 1858.

2491. J. Richmond, Carlisle-terrace, Fairfield-road, Bow, J. Quick, jun., and A. Frazer, Summer-street, Southwark—Construction of a meter for measuring water, spirits, or any other fluids.
2492. M. Osborne, Birmingham — Improved method of ornamenting fenders, stove grates, tables, chairs, and couches made of cast-iron.
2493. E. Alcan, Coleman-street-buildings, London—Method of treating or preparing materials to be manufactured into paper, applicable to lye-washings in general.
2494. A. H. Dendy, 27, Fortess-terrace, Kentish-town — Construction of breakwaters or wave-screens.
2495. J. Wardill, Commercial-road East—Purchases for the raising and lowering of weights by means of chains, especially applicable to ships' capstans and windlasses.
2496. T. McSweeney, 25, Rood-lane—Steering apparatus.
2497. W. Hale, John-street, Adelphi, London—Rockets.
2498. W. Smith, Little Woolstone, Buckinghamshire—Apparatus for supporting the hauling ropes when hauling ploughs and other agricultural implements by steam power.
2499. T. B. Marshall, Queen-street, Cheapside—Drums.
2500. W. C. Cambridge, Bristol —Manufacture of tubular iron, applicable to the construction of whippletrees, and to other uses.
2501. J. F. Amblet and A. Polart, Amiens, France—Manufacture of elastic fabrics.

Dated 9th November, 1858.

2502. E. E. Allen, Brompton-row—Improved machinery for working the propellers of vessels.
2593. J. S. Dawes, Smethwick House, near Birmingham—Improved machine to be used for cultivating land.
2504. J. E. Dickson, 6, Russel-street, Litchurch, near Derby—Railway chairs and other details connected with the permanent way of railways.
2505. J. L. Jullion, Aberdeen, N.B. — Manufacture of paper.
2507. A. Henderson, Gloucester-place, Portman-square — Vessels, and applying rudders thereto.
2508. J. Felix, 54, Rue Croix Nivert, at Grenelle, near Paris—Castors for furniture and other similar purposes.
2509. C. A. Bulkley, New York, U.S.—Apparatus for ginning and cleaning cotton.
2510. W. Clark, 53, Chancery-lane—Signals for railways and apparatus for actuating the same.
2511. S. S. Marling, Stanley-park, and J. Apperley, Dudbridge, Stroud, Gloucestershire — Construction of fulling machines.
2512. V. Newton, 66, Chancery-lane — Construction of stairs.
2513. A. V. Newton, Chancery-lane—Improved apparatus for obtaining extracts or decoctions.
2514. V. Newton, 66, Chancery-lane—Electric telegraphs.
2515. R. A. Brooman, Fleet-street—Electric telegraphing.
2516. R. M. Ordish, Great George-street, Westminster—Permanent way of railways.

Dated 10th November, 1858.

2517. J. Norman and R. Hannah, Glasgow, Lanarkshire, N.B.—Furnaces.
2519. J. Buchanan, Greenock, Renfrew, N.B.—Propelling vessels, ships, and boats.
2520. W. Taylor, Ashby-de-la-Zouch, Leicestershire—Removing the fur from skins and preparing said skins for tanning.
2521. G. Schmidt, Caroline-street, Bedford-square—Construction of core bars.
2522. E. Humphrys, Deptford—Steam engines and boilers.
2523. G. Schmidt, Caroline-street, Bedford-square—Manufacture of cast-iron pipes.
2524. A. J. Brooks, Southsea—Screw propellers.
2525. G. Schmidt, Caroline-street, Bedford-square — Improvement in ladles employed when casting metals.
2526. E. Locke, Newport, Monmouthshire—Construction of gas meters.
2527. C. T. Judkins, York-road, Lambeth—Gas regulators.

Dated 11th November, 1858.

2528. J. Blethyn, Swansea—Manufacture of fuel.
2529. J. and W. Lees, Oldham, Lancashire—Construction of oil-cans.
2530. R. Wright, Openshaw, near Manchester, and T. J. Mercer, jun., Coventry—Improved motive power engine.
2581. E. H. Maberly, Stowmarket, Suffolk—Construction of ships of war and other vessels, their machinery and appurtenances.
2532. M. Benson, Newcastle—Rails for railways.
2533. T. Gray, Bride-lane—Separating wool and animal fibres from vegetable fibres contained in mixed fabrics.
2533. A. V. Newton, Chancery-lane—Improved apparatus for securing doors of safes, closets, and apartments.
2535. J. Rae, Alpha-road, New-cross, Kent—Cisterns suitable for containing water for household uses.
2536. A. Mickelthwaite, Sheffield— Manufacturing buffalo and other horn, so as to be used as a substitute for whalebone and for other useful purposes.
2537. J. Buchanan, Greenock, Renfrew, N.B.—Propelling vessels, ships, and boats.

Dated 12th November, 1858.

2538. T. F. Cocker, Sheffield—Manufacture of steel and iron wire, also of sheets and strips of steel.
2539. J. Ogden, Liverpool, Lancashire—Shuttles for looms.
2540. J. G. Martien, Ampthill-square—Manufacture of iron.
2541. D. Turner, High-street, Whitechapel—Manufacture of wood soles for clogs, boots, and shoes.
2542. G. T. Bousfield, Loughborough-park, Brixton—Apparatus for illustrating conic sections and the lines of the globe.

Dated 13th November, 1858.

2543. M. N. Mills and N. Sidebotham, Ashton-under-Lyne, —Looms for weaving.
2544. J. Benyon and J. W. B. Bowden, Swinton, near Manchester—Looms for weaving.
2545. J. Wadsworth, Salford, Manchester—Construction of moveable or adjustable heels for boots and shoes, and of spurs adapted thereto, to be used therewith.
2546. W. Ashton and T. Cartmell—Air pumps.
2547. J. Courage, Horsleydown, Surrey, and F. Bennett, Holywell, Flintshire— Furnaces for reducing and smelting ores, scoria, slag, and waste.
2549. D. Auld, Glasgow—Furnaces and boilers, and in the generation and treatment of steam.
2550. M. Swan, Henstridge-villas, St. John's-wood—Construction of floating docks and other floating structures.
2551. L. Petre, Hatton-garden—Application of glass to ornamental and useful purposes.
2552. I. Livermore, 5, Shrubland-grove East, Queen's-road, Dalston—Manufacture of shuttlecocks.
2553. M. L. J. Lavater, Strand — Manufacture of mats, coverings for floors and other surfaces.
2554. C. J. Thomas, T. Thomas, H. Thomas, and C. Thomas, Bristol—Manufacture of caustic alkaline lees.
2555. A. B. Woodcock and J. M. Dunlop, Manchester—Covering rollers, shafts, and tubes of any figure or material, with elastic shells or covers of vulcanised india-rubber.
2556. D. Frodsham, Rose-cottage, Gurney-road, Stratford—Apparatus used in combination with fire-boxes of tubular steam boiler, in order to supply air and steam thereto.
2557. M. Pullan, Horsforth, near Leeds —Machinery for drying yarns and other materials.
2558. J. A. Hopkinson, Huddersfield—Steam boilers.

Dated 15th November, 1858.

2559. S. St. Clair Massia, Welbeck-street, Cavendish-square —A new economical guard for candles and wax lights.
2561. A. Dick, Holywell, Flintshire — Manufacture of a yellow pigment.
2562. G. Davies, 1, Serle-street, Lincoln's-inn—Process of finishing piled fabrics.
2563. B. Predevalle, Hart-street—Obtaining motive power.
2564. W. G. Armstrong, Newcastle-upon-Tyne—Manufacture of ordnance.
2565. M. G. Deschamps and A. J. Quinche, Rue Beaubourg, Paris—A new compound metal called lutetia metal.
2566. W. Clark, 53, Chancery-lane—Colouring, preserving, and desiccating wood and marble.
2567. W. Clark, Chancery-lane—Advertising.
2568. J. G. Bunting, Trafalgar-square, Charing-cross — Horse-tamer or break.

Dated 16th November, 1858.

2569. J. Brennand, Manchester—Method of effecting the locomotion of carriages.
2570. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for kneading dough or working and mixing plastic materials.
2571. J. C. Boisneau, Chatellerault, France—An improved horse-mill or gear.
2573. J. Samuel, Great George-street, Westminster — Sleepers or bearers of rails.
2574. S. Taylor, Temple—Fountain pens.
2577. T. Knauth, New York, U.S.—Fire-arms and ordnance.
2578. A. M. Bruere, Paris—The novel application of hydrogen gas to various purposes in the arts.

Dated 17th November, 1858.

2579. F. A. Gatty, Accrington, Lancashire — Producing certain colours on cotton, linen, and silk fabrics.
2580. S. Hoga, 14, Nassau-street, W. P. Pigott, 16, Argyle-street, Regent-street, and S. Beardmore, 37, Upper Berkeley-street West—Electric telegraphs.
2581. M. A. Muir and J. Mellwham, Glasgow—Looms for weaving.
2582. C. F. Vasserot, 45, Essex-street, Strand—A water-proof coating.
2583. C. F. Vasserot, Essex-street, Strand—A flat clothes smoothing-iron, with moveable handles.
2584. T. J. H. Tuck, Great George-street, Westminster—Mode of laying and securing telegraphic cables.
2585. D. W. Hayden, Coleman-street, Arlington-square—Apparatus for beating water and other liquids.
2587. J. Robertson, St. Ninians, Stirling, N.B.—Musical instruments.
2589. E. Mellor, Rochdale, Lancashire—Mules and other machinery for spinning cotton and other fibrous substances.
2590. M. Caton, Preston — Treading motion of looms for weaving.
2591. J. Brennand, Manchester—Ploughs, and other agricultural implements.
2592. R. A. Brooman, 166, Fleet-street—Apparatus for the manufacture of lace and net.

2593. S. Wheatcroft, Brudenell-place, New North-road—Improved apparatus for uniting lace to blond and other fabrics.
2594. J. Platt, Oldham, and H. Chubb, Brecknock-crescent, Camden-town — Apparatus for making bricks or tiles.
2595. W. Clark, Chancery-lane—A process of thickening, strengthening, and improving tanned hides.
2596. H. Douglas, Bart., Green-street, Grosvenor-square—Screw propellers.
2587. W. Clark, Chancery-lane—An improved bit or bridle for horses.

Dated 18th November, 1858.

2598. S. Riley, Oldham—Manufacture of hats, bonnets, and caps.
2599. C. Cowper, 20, Southampton-buildings, Chancery-lane—Separating combed fibres.
2600. E. Briollet, 58, Torrington-square—The obtaining of caloric by a new chemical and mechanical process.
2601. Sir C. T. Bright, Harrow Weald, Middlesex—Insulators, and improved mode of connecting insulators to posts and other supports.
2602. J. and H. Sharp, Bradford—Jacquard machines employed in weaving.
2603. H. Stott, Greetland, near Halifax—Warping mills.
2604. J. Leslie, Conduit-street, Hanover-square—Manufacture of gas.
2605. J. Oakes, Exeter-row, Birmingham—Manufacture of spurs.
2606. J. M. Miller and J. Fear, Barnstaple—Machinery for winding fibrous substances or materials when in the form of thread or yarn on to the bobbins or wheels used in lace machinery.
2607. D. Stoten, Ponder's-end, Middlesex—Ploughshares.
2608. E. T. Archer, Bridgefield-house, Wandsworth—Hat ventilators, and for appliances connected therewith.
2909. B. Rider, 61, Red Cross-street, Borough—Ventilating hats and caps, and in the preparation or manufacture of the material of which those articles are made.

Dated 19th November, 1858.

2610. P. Marchand, E. Marchand, and J. Marchand, Dunkirk, France—A new process for refining lamp oil.
2611. J. Brown, Bolton-le-Moors — Index and Jacquard machines.
2612. W. S. Hayward, Wittenham House, Abingdon—Manufacture of a glutinous substance to be used in the manufacture of paper and in dressing textile fabrics.
2613. G. Howe and J. Norton, Sheffield—Method of boiling water or worts for breweries, distilleries, &c., by steam.
2614. S. C. Leech and J. Leech, Manchester—Construction of self-acting temples, to be employed in looms for weaving.
2616. W. Hancock, Upper Chadwell-street.—Manufacture of electric telegraph wires and cables.
2617. J. Edwards, 77, Aldermanbury — Manufacture of trouser buttons.
2617. C. F. Vasserot, 45, Essex-street, Strand—Apparatus for condensing and cooling vapours and liquids.
2618. H. H. Henson, 38 Parliament-street—Waterproofing fabrics.
2619. W. Ramscar and J. G. Scott, Manchester—Fire-arms.
2620. E. A. Pontifex, Shoe-lane. External surface condensers.
2621. H. Bailey, 35, Golden-square—Heating razors.
2622. W. Clark, 53, Chancery-lane — Purifying natural phosphates of lime.
2623. A. Felton, 184, Brick-lane, Spitalfields—Fastening buttons and studs to dress and other articles.
2624. J. E. F. Luedeke, Chipping Norton, Oxfordshire—Motive power engines.
2625. W. Marshall, Leith-walk, Mid-Lothian, N.B.—Steam engines.
2627. A. J. Thorman, 8, Lime-street, City — Chain cables and chains.
2628. J. Easton, sen., and C. E. Amos, The Grove, Southwark—Improved apparatus applicable to drains, sewers, and water-courses, for the purpose of removing extraneous solid matters therefrom.
2629. A. V. Newton, 66, Chancery-lane—Improved apparatus for transmitting motive power.
2630. T. S. Cressey, High-street, Homerton—Machinery used in the manufacture of casks.

Dated 20th November, 1858.

2631. R. Warry, Chatham—Loading cannon at the breech.
2632. J. Wadsworth, Salford—Gas burners, and in the means for moderating or retarding the flow and pressure of gas used for purposes of illumination, and in street lamps or lanterns for shielding flame from the action of wind and rain.
2633. C. F. Vasserot, 45, Essex-street, Strand—Fire-arms and ordnance.
2634. D. Rowan, and S. Robertson, Greenock — Steam engines
2635. H. Ellis, Holbeach, Lincolnshire—Apparatus for cultivating, cleaning, and pulverising land.
2636. C. Tomlinson, Worcester-street, Wolverhampton—Stop taps or valves.
2637. C. Cuit, Paris—Railway brakes.
2639. R. A. Brooman, 166, Fleet-street—Manufacture of dolls, statuettes, figures of animals and others, and toys.
2640. H. Jordan, Liverpool—Imp. applicable to navigable vessels.
2641. D. Evans, Chobham-cottages, New-town, Stratford—Tubular steam boilers and fire-places.
2642. L. Percivall, Birmingham, and J. Houghton, Edgbaston, Warwickshire—Imp. in attaching knobs of glass, china, and earthenware, to the spindles of locks and latches, and to doors, and other articles.
2643. J. Young, Wolverhampton—Fastenings for window sashes and casements.
2644. H. Swan, 5, Bishopsgate without—Stereoscopes and other optical instruments, and in stands or supports for stereoscopes.
2645. H. Boden, Crescent-cottage, Cambridge-heath, Hackney, and T. Cooper, Ann's-place, Hackney-road—Plaiting or braiding machinery.
2646. H. Gardiner, New York, U.S.—Compound axle hub and wheel for railroad cars.

Dated 22nd November, 1858.

2647. C. H. Mellor, Oldham — Manufacture of woven fabrics.
2648. R. Nelson, New York, U.S.—Apparatus for raising and lifting water and other liquids.
2649. F. A. Theroulde, 67, Rue Caumartin, Paris—Obtaining salts and products from the ashes of marine plants.
2650. S. W. Johnson and J. Varley, Peterborough—Pressure and vacuum gauges.
2651. A. V. Newton, 66, Chancery-lane —Apparatus for propelling and steering vessels.
2652. E. H. Bentall, Heybridge, Essex—Construction of turnip cutters.
2653. T. Spencer—Manufacture or construction of springs.

Dated 23rd November, 1858.

2654. W. Ralston, Manchester—Embossing and finishing woven fabrics.
2655. W. H. Dawes, Bromford Iron Works, West Bromwich, Staffordshire—Forge hammers, and in the anvils used with forge hammers and squeezers.
2656. W. Gorman, Glasgow—Furnaces, and in the combustion of fuel, and in apparatus connected therewith.
2657. J. Fairweather, Dundee, N.B.—Weaving bags, sacks, and other tubular fabrics.
2658. N. F. Boreïko de Chodzko, Paris—A smoke-preventing apparatus.
2659. V. Newton, 66, Chancery-lane—Retorts for generating illuminating gas.
2660. V. Newton, 66, Chancery-lane—Improved machinery for sweeping floors.
2661. W. Warne, J. A. Jaques, and J. A. Fanshawe, Tottenham—An improved fabric, applicable for covering floors and walls, and for other analogous purposes.

Dated 24th November, 1858.

2662. R. H. Hughes, Hatton-garden—Apparatus employed when lighting by gas.
2663. R. A. Brooman, 166, Fleet-street—Cigar cases.
2664. Sir Charles Shaw, Old Cavendish street—Construction of ball and bullet proof shields or mantlets.
2665. W. E. Newton, 66, Chancery-lane—Mills for grinding corn.
2666. A. V. Newton, 66, Chancery-lane—Improved machinery for making bolts and rivets.
2657. R. H. Hess, Islington—A new manufacture of articles and ornamental works from talc and other silicates of magnesia.
2668. C. Peterson, Lowcliffe-lodge, Isle of Wight—Manufacture of paper cartridges, and in paper applicable for waterproof purposes.
2669. J. S. Nibbs, Aston, Warwickshire—Lighting, heating, and ventilating.
2670. J. H. Johnson, 47, Lincoln's-inn-fields—Employment of electricity as a motive power.

Dated 25th November, 1858.

2671. C. E. Amos, The Grove, Southwark—Improved apparatus for raising and supporting ships or vessels while undergoing repair, which apparatus is also applicable for facilitating the passage of ships or vessels over bars, sandbanks, or in shallow waters.
2672. F. C. Calvert and C. Lowe, Manchester—Manufacture of size.
2673. H. Eastwood, Elland, near Halifax—Purifying gas for illuminating purposes.
2674. R. Bodmer, 2, Thavies-inn, Holborn—Valves for regulating the supply of steam.
2676. C. F. Vasserot, 45, Essex-street, Strand—An improved petticoat and bustle.
2677. J. Nuttall, Old Accrington, G. Riding, Clayton-le-Moors, and W. Coulthurst, Old Accrington—Sizes for sizeing cotton linen or other warps or yarns for weaving.
2678. F. H. Maberly, Stowmarket, Suffolk—Candlesticks.
2679. C. Parker, Dundee—Looms for weaving.
2680. F. Loos, Mercer-street, Long-acre — Imp. in gas regulators.
2681. C. Mather, Salford—An improved steam trap for allowing the escape of water and air from pipes, vessels, or chambers heated by steam.
2682. W. Burton, Bethnal-green — Preparing colouring matter for dyeing.

Dated 26th November, 1858.

2683. J. Luis, 1B, Welbeck-street, Cavendish-square—A new sort of drawers or trousers for ladies or children.
2685. E. Dixon and J. Fisher, Wolverhampton—Manufacture of welded iron tubes.
2687. M. Meyers, 9 Great Alie-street, Goodman's-fields—Parasols.
2689. G. Richardson, 1, New Broad-street—Machinery or apparatus for pressing bales of goods.
2691. J. B. Booth, Preston—Machinery for preparing, spinning, doubling, and winding cotton and other fibrous materials.
2693. P. Griffiths and J. Brennand, Burnley, Lancashire—Lubricators for introducing lubricating matter into steam cylinders and other chambers or parts under pressure.

Dated 27th November, 1858.

2695. J. Tangye, Birmingham—Hydraulic presses.
2697. G. Collier, Halifax—Means or apparatus employed in weaving.
2699. F. C. Kinnear, Hoxton, and D. Posener, Windmill-street, Haymarket—Means of preserving life and property in navigation.
2701. C. Burrell, Thetford—Traction engines and carriages.
2703. W. Tillie, Londonderry, Ireland—Manufacture of shirts and shirt fronts.
2705. H. Gerner, 2, Garway-road, Bayswater—Mode of and apparatus for manufacturing gas for illumination and heating.

Dated 29th November, 1858.

2707. G. Oates, Gatefield Works, Sheffield—Manufacture of scissors.
2709. F. S. Perrare-Michal, 20, Rue de la Chaussée d'Antin, Paris—Manufacture of bridles (without bits and without curb-chains) for riding, driving, or otherwise conducting horses.
2711. W. E. Newton, 66, Chancery-lane—Improved expansion or cut-off gear, for steam-engines.
2713. W. Parsons, Bittern, near Southampton—Doing away with the smell arising from the melting fat, tallow, &c., and also for an improvement in stirring and straining the same.
2715. J. Lea and W. A. Sherring, Cecil-court, St. Martin's-lane—Treatment of vegetable fibres for the manufacture of paper, spinning, and other purposes.
2717. J. H. Johnson, 47, Lincoln's-inn-fields, locomotive engines.
2719. L. A. Normandy, jun., 67, Judd-street, Brunswick-square—Imp. in manufacturing files.
2721. J. Gresham, Hull—Apparatus for preserving ship's papers, and other papers and writings, in case of loss or accident to a ship whilst at sea.
2723. D. Evans, Chobham-cottages, New Town, Stratford, and G. Jones, Charlotte-place, Upper Kennington-lane—Pumps and water-gauges.

Dated 30th November, 1858.

2725. J. Luis, 1B, Welbeck-street, Cavendish-square—A new railroad with continued supports splintered together without any wood being used.
2727. A. Marks, London-wall—Manufacture of braided articles.
2729. J. Thow, and T. Hall, Preston—Preventing the fusion of the fire-bars in locomotive or other furnaces.
2731. G. Boccius, Totnes, Devonshire—Construction of furnaces.
2733. J. Colyer, Leman-street—Machinery for cutting and shaping staves and other parts of casks.

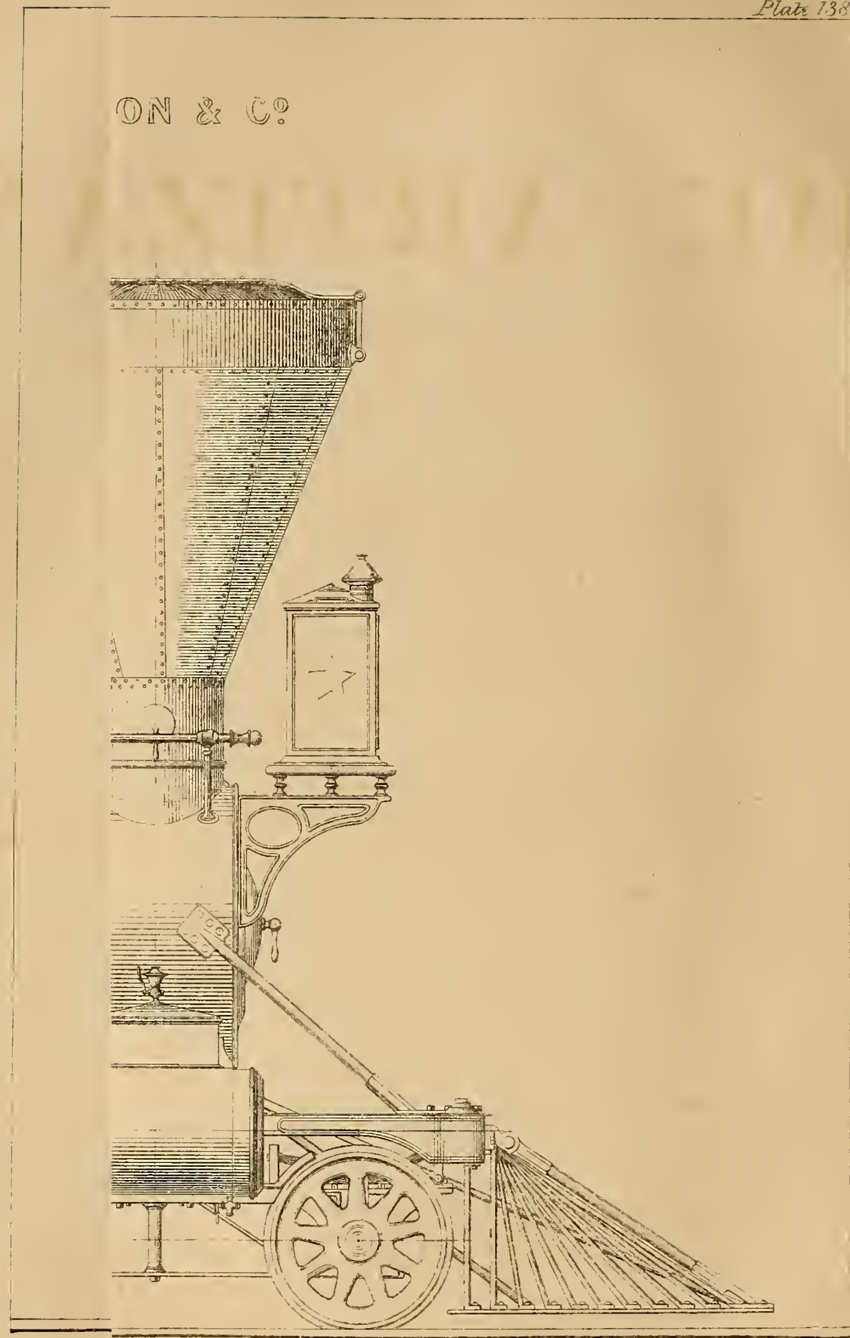
Dated 1st December, 1858.

2735. A. Stenger, 4, Gresham-street—Manufacture of cravats, braces, belts, and waistbands.
2737. J. Loach and J. Cox, Birmingham—Ornamenting the surfaces of japanned goods, and which said improvements are also applicable to the ornamenting of other surfaces.
2799. T. P. Purssglove, Battersea—An improved pressure gauge for steam, gas, or other fluids.
2741. C. F. Vasserot, 45, Essex-street, Strand—An apparatus for printing with different colours thread, to be applied to the manufacture of textile fabrics.
2743. E. Viney, Cornhill—Construction of portmanteaus, desks, dressing-cases, and other like articles.
2745. F. Warner, Jewin-street, J. Derbyshire, Longton, and A. Mann, Little Britain—Manufacture of cocks or taps.
2747. H. Bessemer, 4, Queen-street-place, New Cannon-street—Railway and other wheels and wheel tyres.
2749. A. E. Davis, 1, Pulboro'-place, Harleyford-road, Vauxhall, and R. Wright, 28, Grosvenor-park, Camberwell—Manufacture of colouring matter for spirits and other liquids.
2751. L. Bissell, New York, U.S.—Trucks for locomotive engines.
2753. E. L. Benzon, Sheffield—The manufacture of useful alloys of aluminium.

INVENTION WITH COMPLETE SPECIFICATIONS FILED.

2560. T. R. Butcher, F. Stevens, W. T. Johnson, and T. Jarvis, Frome, Somersetshire — Hammer rails of pianofortes.—15th November, 1858.
2575. C. J. C. Perry, Williamstown, Victoria—An instrument to be used chiefly on board ship for approximating in certain cases the course of an approaching vessel, either in the day or night, and the relative angle of both ships' courses to avoid a collision, to be called "Perry's Anti-collision Dial."—16th November, 1858.
2675. J. Luis, 1B, Welbeck-street, Cavendish-square—A safeguard against burglars—25th November, 1858.
2809. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—An improved apparatus for ascertaining and registering the work of certain kinds of lever balances.—7th December, 1858.

Plate 138.



W. Smith, (

THE ARTIZAN.

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COPPER MINING IN THE SOUTH OF SPAIN.

When in the sixteenth century the genius and enterprise of her navigators had laid open to Spain the almost fabulous riches of a new world, her own internal resources—although in some respects rich and important beyond those of any other European country—seem to have been gradually neglected, and arts and commerce, which up to that time had been successfully pursued, appear to have dropped into a state of desuetude. Intoxicated with anticipations of boundless wealth from the golden regions of the West, the means of acquiring it by a more tedious process became distasteful; and this feeling seems to have been shared with the people of Spain, even by the Government.

From a very remote period the mineral wealth of Spain has been a remarkable and characteristic feature of the country. In the most ancient times, the Iberian lead mines brought Phœnician commerce to her shores; and during the Roman occupation the mines of lead, and copper, and quicksilver were actively and profitably worked. Actuated by the same indomitable spirit and concentrativeness which conducted them during the time of the Republic to conquest wherever they turned their arms, the Roman people, even when applying themselves to industry, have left behind them unmistakeable evidences of their skill and perseverance. Within the present century there existed in the south-eastern part of Spain, in the provinces of Murcia and Almeria, enormous mounds of lead scoria, from which, owing to the insufficiency of the ancient processes of extraction, the lead had been but partially removed; and from which the improved methods of modern times have enabled metallurgists of a later day to obtain a rich yield of metal. The most remarkable proof of the skill and energy of the Roman miners is not found however in the lead mines of the provinces just mentioned, nor in the quicksilver mines of central Spain, but in a locality which has been hitherto but little known beyond its own boundaries, although it is doubtless one of the most interesting and valuable in the world in a mineralogical point of view.

In this district, mining seems in a general sense to have died out with the Romans themselves. The lead mines of the south-east, the smelting-works near to Carthago Nova (the modern Carthagena), the quicksilver mines of Almaden, appear all to have remained in active operation after the Roman period, up to the time of the discovery of America ; but in the district of which we purpose to give some account all activity vanished with the enterprising and dauntless people in whom it originated, and with one solitary exception, the numberless productive mines which in ancient times characterised the locality, until within comparatively a few years, have laid absolutely quiescent and unfruitful. When, after the discovery of South America and Mexico, the expectations of the Government and people of Spain were raised to an inordinate height as to the metallic wealth obtainable from the new world ; all mining enterprise in the mother country was stopped by law, the Government retaining in its own hands three great mines—one of lead, in a locality which has since become known through the establishment of the Linares English Company, one of quicksilver at Almaden, and the third of copper, at Rio Tinto, in the province of Huelva. These mines have been worked up to the present time, but imperfectly, and entirely without the assistance of improved appliances ; occasionally they have been farmed out to speculators, but have been again taken into the hands of the Government, by which they are at present worked.

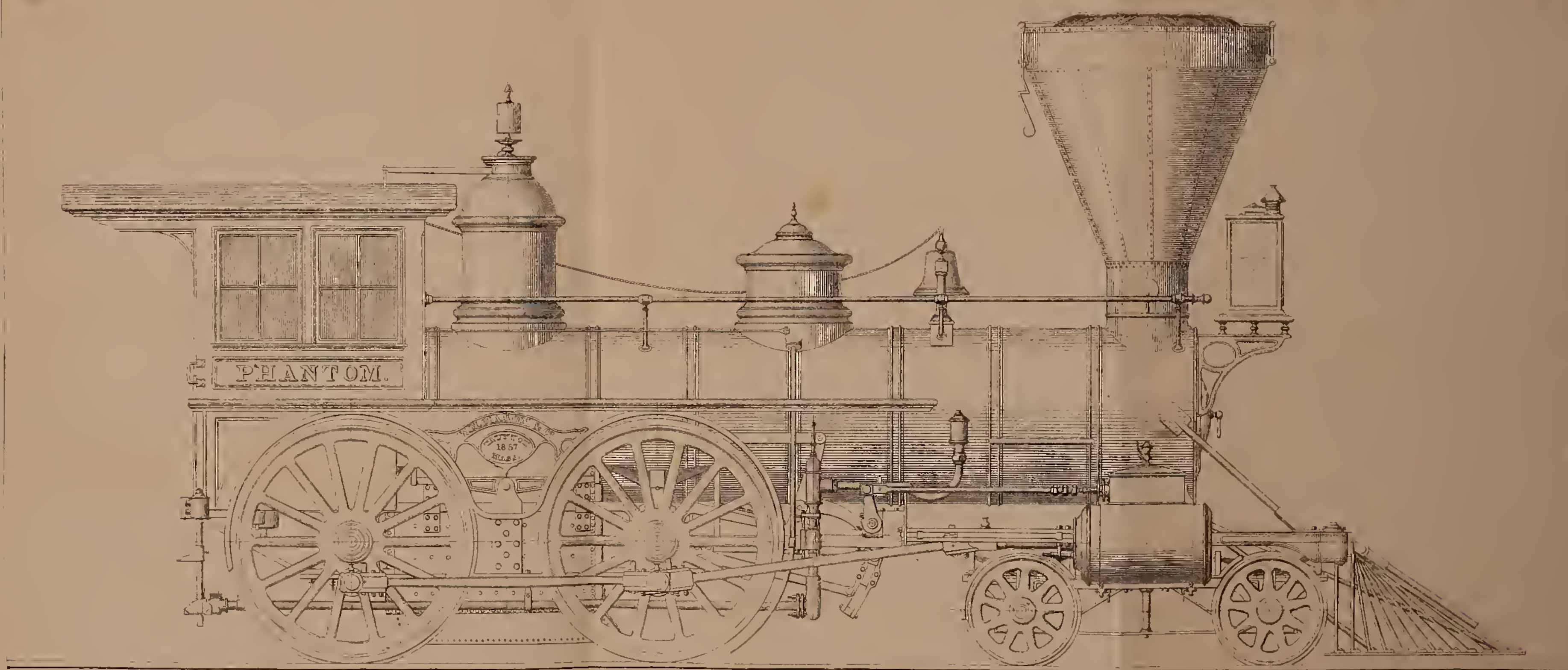
In 1825, the law prohibiting the working of mines by private individuals was repealed, and since that time mining operations have been vigorously pushed forward, but according to rude and antiquated principles; and although the mines of Spain are at this moment the most productive in Europe, and the country itself must be considered a most valuable mineral region, it is well known that not one-fourth of the riches are obtained from the mines which they are capable of yielding. In the province of Huelva, wherein the great Government mine Rio Tinto is situated, there exists an accumulation of deposits of copper, —if such an expression be admissible,—which extends in an easterly direction into the province of Seville, and to the westward into the southern part of Portugal, reaching to the sea. It is a remarkable and even a surprising circumstance, that although the Rio Tinto mine is known to have been worked from the time of the Romans to the present day, during not less than 1,800 years, and the workings can be traced back century after century, the capabilities of the district at large remained unheeded or undiscovered until a very late period. This is the more extraordinary as the evidences of the presence of copper are extended beyond the immediate neighbourhood of this mine, and the waters of the river from which it takes its name, Rio Tinto, are impregnated with the metal.

The mass of copper ore existing in this mine can in no respect be compared with the lodes of Cornish and other mines: it is nothing less than an immense aggregation of mineral of a uniform character, compact in structure and containing scarcely any foreign matter. The deposit, as it runs through the Rio Tinto mine, acquires in some places a width of 100 yards, and is of an average width of 80 yards throughout. Its depth is incalculable; as at present, although the mine has been sunk to a sixth level, the mass of ore increases in width, and it is impossible to form any idea of the vastness of the mass in which the miners are now burrowing here and there, meeting in every direction with nothing but the pure mineral. An eminent English mining engineer who visited this mine has stated that it was with absolute wonder that he found himself, in passing through the different workings, threading in every direction a solid deposit of pyritic copper ore, not existing in lodes but in one boundless compact mass,—floor, sides, supports, roof, all of the same character.

The percentage value of this ore in copper is small, seldom exceeding 4·5 per cent.; although since other mines have been opened in the same

WOOD-BURNING PASSENGER-LOCOMOTIVE, BY Wm MASON & Co

TAUNTON. MASS. U.S.



SIDE ELEVATION.

Inches 12 9 6 3 0 1 2 3 4 5 6 7 8 9 10 Feet

W. Smith C.E. drew

district, deposits have been discovered containing a very much higher percentage of the metal. It is, however, upon the ore of small value that the operations at Rio Tinto are carried on: this mineral contains copper, iron, sulphur, and a little earthy matter; the sulphur on the whole amounting to about 45 per cent. The ore is too poor generally to bear the cost of exportation,—at least, such was the case until within a very few years; it is therefore worked on the spot by a peculiar process, which has only been adopted in a few localities, and which is only applicable to sulphureted ores. This process, which is called cementation, has been long employed in Sweden, and is now used upon the Wicklow ores at the mines; precisely the same treatment, in principle, is applied to the alum schales, in the North of England, in the manufacture of alum. The process itself consists in roasting the sulphurets of iron and copper in the open air: a huge mound of the broken-up ore is so piled upon a foundation of brushwood, that when the latter is ignited the flame can gradually penetrate the heap. The ore, owing to the large quantity of sulphur which it contains, burns readily, emitting a great deal of sulphurous acid gas; at the same time, the sulphur combined with the copper and a portion of that combined with the iron, are oxydized and converted into sulphuric acid, which remains in union with the copper and a portion of the iron. This process of burning or calcination is continued upon the ore during five or six months, until, indeed, the sulphur begins to be exhausted. The result of the calcination is the conversion of the sulphurets of copper and iron, which are insoluble in water, into sulphates of the same metals which are soluble; so that when the ore is afterwards treated with water in great tanks employed for the purpose, the copper, with some iron, is washed out and remains with the water; thence it is recovered in the metallic state by plunging in the liquid plates or pigs of iron, which, according to a well-known chemical action, causes the precipitation of the copper in the form of metal, which has afterwards to be refined and run into ingots for the market.

By this simple and inexpensive process—the details of which we are compelled by want of space to pass over—thousands of tons of the poor ore of the Huelva mines are now being reduced: but in addition to this a new state of things has arisen, which gives a further value to the district. It is generally known that the enormous quantities of sulphur which are annually consumed in this country, in the manufacture of sulphuric acid, were for a long period drawn almost exclusively from the kingdom of Naples,—a circumstance so important to this country as to possess even a political influence. The ores of Huelva, containing as we have seen a great excess of sulphur, which can be easily obtained from them in burning, are perfectly suitable to the production of sulphuric acid; and from this a large trade has sprung up, the ore being now introduced into this country, and after being deprived of the sulphur by the vitriol manufacturers in the neighbourhood of Newcastle, Glasgow, and Liverpool, are sold and smelted as copper ores in the usual manner.

The mine of Rio Tinto is the type of the district, with regard to the character of the ore, and the system of working it; but within a few years the locality itself has received the attention it merits from the Spanish Government. A proper survey showed that the Romans had extended their mining operations as far as the deposit of ore can be traced: ancient adits and shafts have been discovered in all directions, and when cleared from the accumulated detritus with which they are choked, have in almost every instance led to masses of ore similar to, though generally less in extent than, that of Rio Tinto. The consequence has been the re-opening of many of the old mines; which are now in a state of productiveness, yielding a prodigious quantity of ore, part of which is exported for its sulphur, and the rest treated by the process described, to obtain from it the copper in the metallic state.

To the geologist this district must afford as much interest as to the miner and mineralogist, the situation of the deposit of ore being most remarkable with reference to the rocks in which it is found. The general character of the district is clayslate, with protrusions or eruptions of porphyry, which has evidently been thrown up, so as to cause disruption and extensive disturbance of the slate: it is not as veins traversing the rocks that these metalliferous deposits exist, but as masses filling cavities between the slate and the porphyry. Viewed generally, this district of Huelva and part of Seville is therefore one which ought to attract the attention not only of miners but of the scientific mineralogist. Commercially, it is daily being brought into notice both in France and England. T. W. K.

WOOD-BURNING PASSENGER LOCOMOTIVE.

By William Mason and Co., Taunton, Mass., U.S., &c.

Illustrated by Plate, No. 138.

We last month published a large folding Plate, illustrating the construction of an American passenger locomotive engine, the furnace or fire-box of which is designed for the use of wood fuel. The sectional elevation and plan, given in Plate 137, have the dimensions of every part accurately figured in, which renders them of great value to the engineer and the student.

With the present Number we give a side elevation of the same engine illustrated by Plate 137, but on a reduced scale, and exhibiting various fittings and accessories which, for the sake of clearness, and to economise space, were omitted from the former illustrations.

This engine represents the standard modern practice of locomotive engineers in the United States—horizontal cylinders and coupled wheels. It is distinguished from English engines by the bogie, or "truck," in front, for facilitating the passage of the engine round the guide-curves, common on American lines;—by the chimney, or "stalk," funnel-shaped, having deflectors inside to throw down wood sparks and collect them;—by the "cab," or house for the protection of the engineman and fireman—a feature worthy of adoption in this country.

The wheels are of cast iron, with hollow spokes; and the driving and hind wheels are coupled—an old practice which English engineers are only within the last two or three years adopting generally for passenger traffic. The sand-box is on the middle of the boiler, and the alarm-bell near it, pulled by a chain to the cab. The fender in front is to drive off stray cattle—more frequently occurring in America than in this country. The head-lamp is large and powerful. The framing is made of bars welded and framed together: plate-frames are scarcely known in America. The link-motion is adopted in this engine, and it is rapidly superseding the old "hook" motion and double-valves. The grate is of cast-iron. There are air-vessels on the feed-pumps. These and other details are clearly exhibited in the plates.

We are indebted for these illustrations to the courtesy of the Authors and the Publishers of "Recent Practice in the Locomotive Engine," which we briefly noticed in The Artizan for December last, and having promised to give illustrations therefrom, we have thus been enabled to perform that promise; and we have much pleasure in recording our opinion of the very complete and masterly manner in which Messrs. D. K. Clarke and Z. Colburn have treated the subject in the four numbers already published, and which, by-the-by, are got up in the usual excellent style of Messrs. Blackie and Son, the publishers, who also issued the former work by Mr. D. K. Clarke—"Railway Machinery."

LEAD SHOT MAKING.

(Illustrated by Plate 139.)

In continuation of the series of Plates illustrating the manufacture of Lead Shot, we now give four views of the Shot Tower. Fig. 1 being a front elevation of the building; Fig. 2 an end view; and Fig. 3 a back elevation. Fig. 4 is a ground-plan of the tower and of the disposition of the rooms in which the various operations connected with the melting and mixing of the metal, the sorting and storing of the finished shot, &c., are carried on.

In the next and succeeding Plates of this series, will be found views of the various mechanical and other contrivances employed in shot making, which will be minutely described.

HOW DIES ARE MADE.

The very brief and perhaps somewhat imperfect account of "how money is made" which appeared in our January Part, may be, not inappropriately, it is thought, followed this month by some remarks upon the manufacture of dies. In the London Mint there is a separate department for this especial purpose. Cast-steel bars are here transformed by a variety of processes into the beautifully impressed *seals*, so to speak, which stamp the whole of the well-finished coinage of this kingdom. With as much brevity as is consistent with clearness we shall advert to the different stages through which a die passes before reaching the coining press.

After the engraver has completed the device which is to appear upon a new coin—say, for instance, a florin, or some other member of the decimal family—he copies it carefully upon a well-prepared piece of softened steel of the requisite dimensions for his purpose, and commences engraving it with small steel tools. Having, after an amount of tedious and sedentary labour altogether unknown to those of more physical activity, completed his work in *intaglio*, and satisfied himself, by taking repeated impressions in clay, of its good effect and finish, the engraver proceeds to the next operation, that of hardening it. Here he is met by practical difficulties which are sometimes insurmountable, and which may mar the entire work which has cost so much time and care. It is highly necessary that the face of the die be protected during its hardening. Various substances have been used for this, but linseed oil and lampblack are effective enough. This is thinly spread over the surface of the die, which is next placed face downwards, and surrounded by powdered charcoal. It is heated to a particular temperature, and in that state plunged into cold water. In this latter it is kept in a state of agitation until all ebullition ceases.

Much of the art of die-hardening must be got at by practice alone, and as none of our readers contemplate establishing private mints—which, although permissible in Mexico, are quite illegal in England—it may be not worth while going minutely into the signs and portants which speak of the quality of the die and enable the hardener to judge of its chances of standing its work when completed.

The die, which we have thus far watched from the forge, where it was cut from the end of a square bar of steel, until it has gone through the hands of the artist and the ordeal by fire, is now prepared for tempering. This is another operation which requires care and practice. At the Royal Mint both exist, and failures consequently uncommon. We have now a matrix, the parent of the punch, destined in its turn to be the fruitful author of many money-making dies. In order to produce the punch, another piece of softened steel is obtained from the bar, and turned obtusely conical on one end and flat on the other. In this state it is placed on the bed of the die-press, with the matrix immediately above it, its face (that of the matrix) resting on the top of the cone. A heavy blow is next given by the force of several revolutions of the heavy fly-arms of the press. After one such striking a considerable effect will be found to have been taken upon the coned and soft steel. A portion of the engraved work of the matrix will have become imprinted upon the embryo punch. Several annealings of the latter and several more strikings in the press, make it a complete copy in relief of the intaglio-engraved matrix. This is placed then on the shelf, its mission for the time being at an end. The punch is now hardened, retouched, if need be, and is ready for use. A large number of impressions, we had almost said, an innumerable supply of coining dies, may now be obtained without much difficulty. Good material in the shape of steel—and that of Turton, of Sheffield, is, we believe, used exclusively now at the Mint—and an ordinary amount of skill in working it are all that is wanted for the production of good coining dies. Short pieces of steel, cut from the bar, forged, and turned conically, as in the case of the punch, are put through the same operations to which it was submitted, and receive from it perfect impressions in intaglio—*fac-similes*, indeed, of the matrix.

Thus are dies multiplied. Afterwards they are put into the lathe, and turned to the proper gauge as regards diameter and height, then hardened, tempered, and submitted to the coiner. It will be observed that by this method of creating dies perfect uniformity is obtained—the coins got up from them *must* resemble each other exactly. Were each die engraved separately, it is needless to say that this resemblance could not be preserved; Her Majesty's benign features, which all love to observe on a piece of gold—of their own—would sometimes be distorted by imperfect engraving, and the counterfeit coiner have a greater chance of success; besides, the expense would be inordinately increased.

As in our last Number the mode of making money was alluded to, the die question may not require further tracing than to say, that each pair of dies ought, with discs of metal of ordinary size and thickness to deal with, to give birth to from 20,000 to 30,000 coins. Small and thin coins are necessarily more fatal to dies than fairer-proportioned ones. In the British coinage the sovereign may be deemed one of the most justly proportioned, as it is one of the handsomest of coins. The half-sovereign, too, has a good device. Humbly and reverently, it might be suggested that Queen Victoria is older now than when the matrixes for the two gold coins mentioned were engraved by the late celebrated engraver to the Mint.

ON THE ECONOMIC PERFORMANCE OF STEAM-SHIPS

Vice-Admiral E. Paris, of the Imperial French Navy, has just issued from the press a work upon this subject, under the title, "Utilisation Economique des Navires à Vapeur; moyens d'appréner les services rendus par le combustible suivant la marche et la grandeur des Bâtiments."

The Author is doubtless known to many of our readers, from having already written several excellent and practical works upon the Marine Engine, the Screw Propeller, &c., &c., which are standard books of reference in the French steam naval departments.

The subject which Admiral Paris treats in the work before us is one which is engrossing a considerable share of attention amongst those of the scientific world connected with steam navigation, and who are interested in the development of economy therein; and so important is the subject considered at the present, that a committee of noblemen and gentlemen of high scientific attainments are engaged upon an extensive series of investigations connected with the subject, having been appointed for the British Association for the Advancement of Science, at the recent meeting at Leeds. We have therefore thought it would be received as very useful and timely service to enter upon the investigation of Admiral Paris's work, and give such extracts therefrom as are in our opinion likely to prove most interesting and serviceable to our readers, although it is but fair to the author to state that we find it difficult to do him sufficient justice in making extracts, however fully, and we hope carefully, we may be able to quote from his work.

As the best way of applying economically any mechanical force is to keep an account of the expense incurred, compared with the result, it has been sought to establish such calculations for steam-ship economy, and the question has been considered from different points of view.

The engineers and shipbuilders anxious to study these products have considered the question on its dynamical side, and then compared together the resistance, the speed, and the force measured by the indicator. But this, however, is quite useless to the seaman who receives a ship with a small engine and confined stowage for coals, and who has had no influence or opinion either in the construction of the hull, or in the disposition of the machinery, but must take her and make the best of the whole.

He compares the result, not to a force measured with but little exactness, but to the coal, which is the first cause of that force. It is a natural consequence that in looking at this new side of the question, the formulæ generally used to obtain what has been called *the efficiency*, have been changed for new ones, in which *coal* is substituted as the measure of the force. This is the main difference of the calculations made in the "Utilisations Economique," when compared with the manner in which the question had been considered by other writers.

Before examining the true objects of the new work, the author considers the variety of the unity of force used now in France, and taking some experiments lately made at Brest and Toulon, he shows seven different values to what is called a H.P., as is shown in the annexed Table:—

	Nominal power, $\frac{2 d^2 c N}{0·59}$	Kilogrammes on the piston, $7{,}117 \frac{a}{2} d^2 c N p$ (1)	Power in horses of 75 kilogrammetres, $\frac{7{,}117 \frac{a}{2} d^2 c N p}{75}$	Power in horses of 100 kilogrammetres, $\frac{7{,}117 \frac{a}{2} d^2 c N p}{100}$	Power in horses of 200 kilogrammetres, $\frac{7{,}117 \frac{a}{2} d^2 c N p}{200}$	Force in horses of low pressure, $\frac{2 d^2 c N p}{0·59 \times 0·63}$	Force in horses of 30 kilogrammes of sensible steam in the cylinder.
Sovereign .. {	615	124,946	1,665	1,249	625	944·5	608
	631	119,380	1.538	1,194	57	872·3	661
Eylau ..... {	801	149,603	1,995	1,496	748	1131·5	696
	701	91,584	1,221	916	408	690	415
Impératrice..	789	132,530	1,767	1,325	662	1002	651
Sèvre	371	30,631	408	306	153	232	168

In all these formulæ a = the number of cylinders; d = diameter of the piston; c = length of stroke; N = the number of revolutions per minute; p = the mean pressure in centimetres of mercury, taken from the mean ordinate of the diagram. In this manner they have the work done by the piston, and to obtain that done by the shaft they deduct 6 centimetres; so it is $p - 6$.

The author proposes to count in kilogrammes, or square centimetres, as the English do in lbs. per sq. in.; and as an atmosphere, or 76 centimetres of mercury, is = 1·033 kilogrammes, or a square centimetre, the formula would become 2,618 $d^2 c N p$ in kilogrammetres, 3,442 $d^2 c N p$ in horses of 75 kilogrammes, and 2,618 $d^2 c N p$, should the H.P. of 100 kilogrammetres be adopted.

TABLE No. I.—SCREW-STEAMERS OF THE IMPERIAL NAVY.——ECONOMICAL EFFICIENCIES ACCORDING TO THE EXPERIMENTS.

Names of Ships.	Length between perpendiculars.	Main beam.	Proportion between preceding numbers.	Displacement.	Displacement $\frac{2}{3}$.	Midship section immerged.	Proportion between preceding numbers.	Speed in knots.	Coal burnt during 24 hours.	Coal burnt during 1 hour.	Theoretical efficiency	Economical Efficiency: Proportion of the midship section $\frac{V^3 \times B_2}{coal}$	Proportion of displacement $\frac{2}{3}$ $\frac{V^3 \times D^{\frac{2}{3}}}{coal}$	Relative efficiency $\frac{V^3 \times D^{\frac{2}{3}}}{coal \times b}$	Means.	To the displacement $\frac{V^3 \times D}{coal}$	Coal burnt to travel 1 mile.	Coal burnt to transport 1 ton of displacement with the speed of the 9th column.	Coal burnt to transport 1 ton displacement to 1 mile distant with the common speed of 10 kts.	Means.	OBSERVATIONS, DETAILS OF TRIALS.
1	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13	14.	15.	16.	17.	18.	19.	20.	21.	22.
	m.	m.	m.	tons.		m.		min.	kil.	kil.							kil.				
Bretagne	81,00	18,08	4,50	6 840	360,3	119,00	3,015	12,15	153 840	6 410	"	33,44	97,14	5,37	4,96	1809	519	0,080	0,045	0,053	Comparative trials of *Bretagne* and *Isly*; full power between Titan and Portcross and back; dead calm and light W. breeze.
	"	"	"	"	"	"	"	10,82	113 040	4 710	"	32,14	93,36	5,16		1739	436	0,067	0,051		
	"	"	"	"	"	"	"	9,04	70 800	2 050	"	29,90	86,90	4,25		1619	327	0,050	0,068		
	"	"	"	"	"	"	"	12,50	177 600	7 429	"	31,42	91,26	5,05		1700	594	0,092	0,047		Report of trials of 10th December, 1855.
Napoléon	71,30	16,22	4,395	5 050	294,0	98,8	2,977	13,5	145 920	6 080	0,192	39,97	119,21	7,35	7,32	2043	450,4	0,089	0,036	0,049	Between Toulon and Marseilles; light breeze, fresh sea, no sails.
	"	"	"	"	"	"	"	12,0	96 960	4 040	0,173	42,26	125,90	7,76		2161	336,6	0,066	0,038		Between les Mèdes and Bagau; stern swell.
	"	"	"	"	"	"	"	10	57 912	2 413	0,184	40,91	121,90	7,46		2093	241,5	0,048	0,048		Between Bénat and Briançon; light head breeze, light cross breeze.
	"	"	"	"	"	"	"	8	33 000	1 375	"	36,79	109,60	6,72		1881	192,0	0,038	0,074		From one extremity of Titan to the other; light head breeze. (What belongs to *Napoleon* is taken from experiments of 1852).
Algéziras	71,23	16,22	4,395	5 121	297,1	99,00	3,000	12,20	89 430	3 726	0,167	48,36	144,98	8,90		2496	305	0,058	0,032		The ship being alone had once 13 knots with 2,239 H.P. of 79 kil., and 0·182 of efficiency.
Comparison of Trials. *Algéziras* ..	"	"	"	"	"	"	"	11,85	105 600	4 400	0,147	37,44	101,2	6,23	*Algéziras,*	1936	371	0,072	0,043	*Algéziras,*	Both ships full power, working alone against a fresh easterly breeze, smooth sea in the beginning, and agitated at the end of a track of 114′.
Arcole	71,30	16,22	4,395	5 051	291,4	99,00	2,972	10,17	119 300	4 971	0,125	20,95	62,29	3,82		1094	489	0,097	0,092		
Algéziras ..	"	"	"	"	"	"	"	11,00	61 600	2 566	0,159	51,35	154,1	9,50	8,82	2656	233	0,045	0,034	0,036	*Algéziras* following *Arcole*, working at full power; calm, smooth sea from Sanguinaires to the Isle of Hyères.
Arcole	"	"	"	"	"	"	"	11,00	134 600	5 608	0,135	23,35	69,9	4,31	*Arcole,*	1199	509	0,109	0,082	*Arcole,*	
Algéziras ..	"	"	"	"	"	"	"	10,92	70 000	2 916	0,166	44,21	132,7	8,18	4,16	2287	266	0,051	0,039	0,084	Both ships, free way, half of fires lighted from the Isle of Hyères to Villafranca, W.N.W., freshening at the end of the track.
Arcole	"	"	"	"	"	"	"	9,62	90 900	3 787	0,156	23,30	69,2	4,27		1187	393	0,078	0,088		
Algéziras ..	"	"	"	"	"	"	"	9,80	36 888	1 537	0,177	60,62	181,9	11,21		3136	156	0,030	0,032		*Algéziras* following *Arcole*, using only the half of boilers from Villafranca to the Isle of Hyères; light east breeze, freshening at the end of the track.
Arcole	"	"	"	"	"	"	"	9,80	95 400	3 975	0,159	23,47	60,2	4,23		1195	405	0,080	0,085		
Souverain......	62,90	16,236	3,878	4 440	270,2	105,00	2,573	0,40	66 960	2 790	0,1213	32,15	82,77	5,09	5,52	1360	294	0,066	0,077	0,058	Mean of four travels between Cape Bénat and Mèdes; all boilers lighted; calm, little agitation on the sea.
	"	"	"	"	"	"	"	10,45	71 360	2 992	0,1433	40,03	103,00	5,69		1693	286	0,063	0,055		Mean of four travels between Bénat and Medes; calm, very smooth sea, all boilers lighted.
	"	"	"	"	"	"	"	9,99	61 410	2 558	0,1412	40,91	105,30	5,74		1730	255,8	0,057	0,056		Mean of four travels between Bénat and Médes; dead calm, smooth sea, all boilers.
	"	"	"	"	"	"	"	9,10	39 430	1 643	0,1812	48,15	123,9	7,64		2036	180,5	0,041	0,055		Travel of 36 miles on the African Coast; calm, smooth sea, three boilers lighted.
	"	"	"	"	"	"	"	6,2	36 150	1 506	0,1381	16,66	42,76	2,44		703	243	0,055	0,231		Fresh head breeze, high sea, three boilers lighted.
Louis XIV.	62,99	16,236	3,878	4 752	282,6	106,05	2,653	8,56	72 00	3 000	0,108	20,04	59,11	3,64	4,11	993	350	0,075	0,119	0,102	Experiments, light breeze, smooth sea.
	"	"	"	"	"	"	"	9,10	68 500	2 854	"	26,40	74,61	4,59		1254	313	0,065	0,086		Experiments, light breeze, smooth sea.
Eylau.........	69,22	16,20	4,272	5 023	293,6	08,70	2,974	12,10	103 000	4 281	0,137	40,85	121,5	7,50	8,9	2079	354	0,070	0,039	0,038	Back from Algiers, 148 miles, light breeze, two points from head, some swell, all boilers lighted.
	"	"	"	"	"	"	"	12,00	101 880	4 245	0,133	40,18	119,5	7,37		2045	354	0,070	0,041		Mean of four trips of 14 miles along the African Coast; calm, smooth sea.
	"	"	"	"	"	"	"	11,60	54 000	2 250	0,188	68,49	203,8	12,58		3485	194	0,038	0,024		Trial with four boilers along the African Coast; calm, smooth sea.
	"	"	"	"	"	"	"	10,88	114 000	4 754	0,1049	26,74	79,64	4,91		1361	437	0,087	0,066		From Cape Sœpet to Mola, fresh S. S. E. breeze, heavy sea; length of trip, 201′ (at the same time as frigates).
	"	"	"	"	"	"	"	7,28	97 300	4 050	0,0155	9,40	27,97	1,72		478	556	0,110	0,285		From Mahon to Point Pescade, strong wind, very heavy sea, the bearings giving a mean speed of 7·10, and the log 8′·58.
Charlemagne ..	60,50	15,75	3,79	4 100	256,2	92,02	2,67	9,5	62 000	2 600	"	30,40	84,05	5,33		1353	274	0,067	0,078		Trials of receipt.
Fleurus	60,77	16,20	3,70	4 400	263,9	96,00	2,707	9,07	43 000	1 792	0,174	39,96	111,8	6,90	3,80	1832	197	0,045	0,065	0,156	Smooth sea, light stern breeze; very short trial.
	"	"	"	"	"	"	"	8,0	60 000	2 500	"	19,65	55,01	3,39		881	312	0,071	0,139		During a whole day of dead calm.
	"	"	"	"	"	"	"	6,6	47 000	1 904	"	14,49	40,53	2,50		664	288	0,065	0,226		During 106 hours of calm.
	"	"	"	"	"	"	"	6,8	52 200	2 133	"	14,15	39,58	2,44		648	313	0,061	0,194		Mean of several days of calm.

Table No. II.—Frigates and Steamers of the Imperial Navy.—Economical Efficiencies according to Trials.

Names of Ships.	Length between perpendiculars.	Main Beam.	Proportion.	Displacement.	Displacement $\frac{2}{3}$ds.	Midship section immerged.	Proportion.	Speed in knots.	Coal burnt during 24 hours.	Coal burnt during one hour.	Theoretical efficiency.	Economical Efficiency. Proportion of the midship section $\frac{V^3 \times B^2}{\text{Coal}}$	Economical Efficiency. By proportion to displacement. $\frac{V^3 \times D^{\frac{2}{3}}}{\text{Coal}}$	Economical Efficiency. Relative efficiency. $\frac{V^3 \times D^{\frac{2}{3}}}{\text{coal} \times b}$	Economical Efficiency. Mean.	Economical Efficiency. To the displacement.	Coal burnt to travel one mile.	Coal burnt to transport 1 ton of displacement to 1 mile distance, with the speed of the 9th column	Coal burnt to transport 1 ton of displacement to 1 mile distance, with the common speed of 10 knots.	Means.	Observations, Details of Trial.
1	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.
	m.	m.		ton.		m²		knots.	kil.	kil.							kil.	kil.	kil.		
Comparative experiences. *Impératrice*…	73,98	14,36	5,151	3 796	243,4	68,47	3,553	10,724	115 000	4 793	0,0937	17,60	49,67	3,46	Impératrice, 7,16 Impétueuse, 4,22	976	447	0.118	0,095	Impératrice, 0,086 Impétueuse, 0,114	From Toulon to Mahon, with *Eylau*—full power in each ship, S.E. breeze, fair sea, gradually rising.
Impétueuse….	72,00	13,00	5,035	3 784	242,8	69,80	3,491	10,02	73 000	3 042	0,080	23,10	80,03	5,61		1251	304	0,081	0,080		
Impératrice…	,,	,,	,,	,,	,,	,,	,,	10,00	86 640	3 610	0,099	18,84	67,04	4,69		1051	361	0,095	0.095		Between Algiers and Marseilles—head wind; *Impétueuse*, 8 boilers; *Impératrice*, 8, 6, and 5 boilers.
Impétueuse. .	,,	,,	,,	,,	,,	,,	,,	10,00	80 880	3 370	0,0752	20,71	72,07	4,48		1123	337	0,089	0,089		
Impératrice…	,,	,,	,,	,,	,,	,,	,,	10,71	60 552	2 523	0,138	33,70	118,50	8,25		1848	235	0,061	0,077		Between Medes and Lardier—little breeze, sometimes ahead, sometimes astern; free way; half of the boilers.
Impétueuse….	,,	,,	,,	,,	,,	,,	,,	8,17	44 606	1 858	0,132	20,72	71,22	4,40		1111	227	0,060	0,101		
Impératrice…	,,	,,	,,	,,	,,	,,	,,	7,99	30 600	1 273	0,161	27.66	97,48	6,79		1521	159	0,042	0,083		Between Medes and Lardier—two inverted travels, smooth sea, fair breeze, *Impératrice* following *Impétueuse*, who did her best, with four boilers.
Impétueuse….	,,	,,	,,	,,	,,	,,	,,	7,99	44 256	1 844	0,124	19,44	67,16	4,14		1046	231	0,061	0,112		
Impératrice…	,,	,,	,,	,,	,,	,,	,,	7,14	28 080	1 170	0,143	21,71	75,55	5,26		1177	163	0,043	0,118		Trial with equal speeds between Medes and Titan—*Impétueuse*, four boilers; *Impératrice* following, with two boilers: fair breeze shifting ahead or astern.
Impétueuse….	,,	,,	,,	,,	,,	,,	,,	7,14	44 256	1 844	0,116	13,52	40,03	2,47		749	258	0,068	0,187		
Impératrice…	,,	,,	,,	,,	,,	,,	,,	12,07	97 320	4 055	0,088	29,69	105,50	7,34		1649	336	0,088	0,050		Between Lardier, Taillat, and Fréjus—little beam breeze, smooth sea; both frigates using all boilers.
Impétueuse….	,,	,,	,,	,,	,,	,,	,,	11,40	by coal measure		0,122	,,	,,	,,		,,	,,	,,	,,		
Audacieuse…….	73,98	14,36	5,151	3 790	243,0	68,47	3,553	8,2	43 620	1 820	,,	19,26	68,40	4,76	4,68	1066	222	0,058	0,113	0,119	Little head breeze, smooth sea; 1½ days travel.
,,	,,	,,	,,	,,	,,	,,	,,	8,0	46 680	1 987	,,	18,87	66,99	4,66		1044	248	0,064	0,125		Little head breeze, smooth sea, little back swift; 12 hours trip.
Isly…………….	70,00	13,00	5,384	2 686	193,2	53,4	3,618	10,79	73 920	3 080	,,	21,81	79,00	6,08	5,68	10,98	285	0,106	0,084	0,090	Comparative trials with *Bretagne*.
,,	,,	,,	,,	,,	,,	,,	,,	10,72	83 470	3 478	,,	19,00	68,60	5,28		954	324	0,120	0,097		
Sèvre…………	,,	,,	,,	3 979	251,1	70,90	3,541	8,82	20 300	846	0,1005	57,50	203,07	,,		3227	96,0	0,024	0,035		Means of four trips, during trials of receipt.
Meuse…………	71,60	12,60	5,682	2 720	194,8	49,14	3,967	7,44	27 000	1 125	,,	17,99	89,79	7,12		995	151	0,055	0,133		Experiments of receipt. Screw of Mr. Holm.
Duchayla…….	60,75	10,90	5,573	1 846	150,5	40,36	3,481	10,61	41 280	1 720	,,	26,74	104,50	9,58		1285	162	0,088	0,074		Abstract of experiments of receipt: speed measured on a base; short of steam.
Phlégéton…….	56,72	11,22	5,046	1 452	128,2	38,50	3,329	11,75	53 600	2 233	,,	27,84	93,12	8,29	8,57	1055	190	0,130	0,081	0,083	Trials of receipt. Weight of coal uncertain.
,,	,,	,,	,,	,,	,,	,,	,,	10,70	38 000	1 583	,,	29,81	99,27	8,85		1124	148	0,102	0,085		
Primauguet……	56,72	11,22	5,046	1 658	140,1	42,20	3,320	10,73	43 680	1 820	,,	,,	101,60	9,05		1203	169	0,102	0,082		Trials at Brest.
Foudroyante ….	53,80	13,35	4,000	1 462	128,8	35,7	3,611	2,6	18 500	771	0,0065	0,814	2,94	0,22		33,00	258	0,176	10,010		Trials of receipt in 1855.
Roland ………	56,00	10,20	5,49	1 299	119,0	37,4	3,181	12,5	48 000	2 000	0,129	36,52	116,30	11,39	9,78	1269	160,0	0,123	0,063		Trials of receipt in 1852.
,,	,,	,,	,,	,,	,,	,,	,,	8,56	20 500	854	0,130	34,56	87,44	8,57		954	99,76	0,077	0,123		
Marceau …….	36,94	7,80	4,72	478	61,22	15,10	4,054	9,00	17 230	701	,,	15,70	63,57	8,15	7,81	497	78,00	0,162	0.222	0,232	Trials of receipt. Speed by patent Massey log from Havre to Cherbourg.
Duroc ………	36,94	7,80	4,72	478	61,22	15,10	4,054	9,00	18 360	765	,,	14,39	58,25	7,47		455	85,00	0,177	0,243		
Alarme………	43,94	7,58	5,665	392	53,56	12,38	4,326	7,5	13 900	579	0,076	9,02	39,02	5,15		286	77	0,196	0,585		Trials of receipt.
Ariel …. …….	40,00	6,60	6,06	225	37,02	9,53	3,989	12,0	22 800	950	,,	17,34	67,30	10,19	9,51	409	79,16	0,353	0,204	0,281	Means of numerous observations made by M. Dupriez, chief engineer, now on board the *Arcole*. Coals had been exactly measured, and in similar circumstances—that is to say, with calm and smooth sea.
								11,3	19 200	800	,,	16,43	66,74	10,10		406	70,80	0,317	0,220		
								10,5	16 800	700	,,	15,76	61,19	9,27		372	66,66	0,295	0,255		
								9,5	13 200	550	,,	14,95	57,67	8,74		351	57,90	0,257	0,300		
								9,1	9 600	400	,,	17,95	69,70	10,56		267	43,95	0,195	0,259		
								8,2	8 400	350	,,	15,01	59,64	9,03		354	42,68	0,189	0,343		
								7,3	6 000	250	,,	14,83	57,53	8,71		358	34,24	0,152	0,391		
Croiseur………	35,40	5,85	6,00	174	31,16	8,08	3,856	9,72	8 448	352	0,0912	21,07	81,29	13,89		454	36,20	0,208	0,224		
Faon …………	40,50	6,19	6,75	187	32,70	8,174	4,000	12,3	19 180	799	,,	19,03	76,43	12,34		439	61,94	0,339	0,183		The *Fawn*, built by M. Moissard. Instead of being the results of trials always made during a calm, they are the means of 282 trips, half of which were during the night between Calais and Dover. The speed has been 14,83 knots steam and sails.
Mutine ………	,,	,,	,,	127	25,27	6,00	4,211	6,0	2 400	100	,,	12,95	54,55	,,		274	16,6	0,132	0,612		

On examining the various methods, it is easily seen that the first is no more than a measure of volume, and not at all of force or power, as the pressure is overlooked; and the second, third, fourth, aud fifth are all based on the number of kilogrammetres acting on the piston, as calculated by the card. The sixth is a kind of correction of the nominal power made for the pressure in use when we began to employ tubular boilers, and the last one is a high-pressure non-condensing, though included with the low-pressure.

As three or four of these different methods of calculating are frequently met with in the same reports of trials, it is easy to perceive what a disorder it produces in estimatiug the qualities of engines. Thus a real H.P. of a new engine costs no more than a quarter of the same in au old engine working at 6 in. pressure.

The author also remarks that the diagram is not a commercial measure, though in fact it is the basis of all bargains, being the only means of calculating the quantity of *sensible steam* in the cylinder, which must be given by the maker in the cylinders. The indicator is an admirable means of testing the internal functions of an engine, but not of measuring its value in pounds and shillings. It gives the power at the very moment the card is traced, and is not a means of measuring the work when lasting a long time; but it can be used to kuow the pressure on the piston of a good many engines, and then by adopting the means — a kind of *gauge H.P. (cheval de jauge)* would be obtained, and calculated as easily as the nominal H.P. for whatever pressure is used in the engine. To show this system, the autbor has taken the mean ordiuate of several ships, and the pressure in the boiler, and he found that by taking the half of this one, he had quite the mean ordinate. This would hold good for high-pressure engines, which would require peculiar trials.

Many more observations would be wanted to admit half the effective pressure in the boiler as representing the value of the mean ordinate; but whatever would be the fraction adopted, it would be a simple manner of calculating *the real power;* and this being specified in the bargains, the indicator would be used to know if the engines perform their duty. If after long use the pressure is diminished, they will have the power really remaiuing; and it would thus furnish a means of understanding each other, which we are quite unable to do according to present practice. As the same disorder exists in England, it is to be wished that some decision should be taken to have a method of measuring the power as simple and practical as that of the tonnage of ships should be. If not truly exact, this method would be much better than that we are using now, and it is the reason of this proposal.

As the engine loses its power by a long working, the French author proposes to make the experiments with a certain number of furnace sheets, this being clearly established in bargains, and being also a security against the loss of production of steam, which is the chief cause of that of speed, when steam-ships are becoming old. So it would be specified that the trials should be made with one furnace sheet on four of them, and uot that the diagrams would give by calculations 30 kilogrammes of sensible steam per H.P. The falling off in steaming power of the boiler is caused by the scale, which eannot be eutirely avoided with our present pressure (20 or 30 lbs. in the sq. in.), and also by the rust, which in the bottom of ships quickly weakens the plates, their rivets, and their stays. So a well-cared engine will work as well as new, and the pressure of the boiler would be necessarily lowered, and a new power calculated; but if there is a sufficient quantity of steam the power will be preserved by using less expansion. Many of our ships became slow because they wanted steam, and they would have kept their speed had what has been said been observed.

The purpose of a force being exerted is to produce motion, the work done beiug measured by the weight moved, and the distance, it would seem easy to know the performance of ships. But they are not in the same condition as weights; their resistance through water is not exactly kuown, and it varies from one ship to the other, according to the variety of forms. This difficulty is probably the cause of the indifference with which this question has been considered, when it has produced in those the remarkable results of the Cornish Association. These prove how desirable it would be to measure the performance of sea steam-engines as well as that of pumping or hoisting eugines. Unfortunately it is not possible, not only because the resistance of ships through water is not well known, but also the action of the propeller, whatever it may be, is unknown. But if true exactness is not possible it is not a reason to abandon the question, and not to search if some observations would not give results of a sufficient exactness for common practice of steam navigation. It is what the French author tried after he had admitted as a principle that the resistance of ships is in the ratio of the square of the speed, and the surface of the midship section, as it has been used by Messrs. Bourgois and Moll, in their valuable trials on various kinds of screws, translated in the "Treatise of the Screw Propeller," by Mr. Bourne. But instead of using the midship section he has adopted the displacement $\frac{2}{3}$, as the Admiralty did in the trials of British men-of-war; and Mr. Atherton, in his work on "Steam-ship Capability," of which an abstract of the text, as well as of several tables, are given in the French work, to show the questiou on the side in which it has been examined in England.

It is only after all these preliminaries that the Admiral Paris enters really into the matter he intends to study, and he explains the reasous of the adoption of displacement two-thirds, instead of the displacement of the midship section, in the following words: "The purpose of a ship is not to set apart water, as a cutting tool does, or rather a plough through the ground under the traction of horses, the real work being expressed by the width and depth of the furrow. The ship cuts the water, but she does so only to transport goods, and her midship section represents only the obstacles to what she intends to perform; but the real work done by her is the weight transported. If she first gives a dynamical result, the second is suited to the economical appreciation; and we can say that if for a mine the work is the quantity of coal hoisted from the well on the sea against the abstract of gravitation, it is the transport of a weight through water; in one case the abstract of gravitation has been overcome, in the other it has been the inertia of water. Then it would be really with the cargo that calculations should be made, as Mr. Atherton did with arbitrary numbers But as the hull and engine are necessary to the transports as well as waggons on railroads, and as the proportions of cargo to the whole weight are very variable, it has been found better to consider the whole, that is to say, the displacement. It is for these reasons that in the second part of the "Treatise on the Screw Propeller" are several tables, in which the coal burnt to carry one ton of displacement a mile has been calculated. We shall see further what can be done with that mode of acting.

Now we must say that for a general measure the displacement cannot be used, because it has too much influence on the result. So if we consider ships of equal relative power, we shall see that their engines will grow larger in the ratio of the square of dimensions, when the volume or weight of the ship will follow the ratio of the cube, and the ship twice the capacity of another will have an engine four times more powerful, but will carry eight times more, so the engine will do double work. Now let us see if the midship section is better fitted to a general measure, and we shall consider that when all ships had $3\frac{1}{2}$ or 4 times their beam for their length, it was quite true, but that now we see daily the proportions of 6, 7, 8, and even $8\frac{1}{2}$ adopted by the best shipbuilders.

For instance, let us suppose an old man-of-war of 100 guns, having 98 metres midship section, and displacing 4,450 tons, and let us suppose another, having the same beam, but having her frames placed double the distance apart; this second ship will have the same midship section, but her displacement will be double. How then can we say that the engine which propels double the weight will have no more power than if simply lifting the weight? Tbis cannot be admitted: however, this is what they do when calculating by the midship section. As a proof, we can see that speed and power being the same, and represented by one, we have in one case $\frac{1\frac{2}{3} \times 1^3}{1}$, and in the second $\frac{2\frac{2}{3} \times 1^3}{1} = 1{\cdot}587$; which is to say, that the economy of the large ship will be to that of the small one as 1 : 1·387—that is to say, that in the case of a ship of 100 square metres midship section, the second one should have 158 metres, and this shows that the *utilisation* calculated witb the imaginary surface called $D^{\frac{2}{3}}$, answers well with a midship section proportional to displacement: there is only this difference, that for the same speed the lengthening of the hull does not require more power, whilst enlarging her would; and that if the first ship has 1,000 H.P., the second should be propelled by 1,587 for the same speed. Here we see a proof of one of the advantages of long hulls: and in the course of this work we shall see many evidences of this important fact.

The *Eylau* is an example of what has just been said. She has heen lengthened 6·75 metres, which for 98·7 metres of midship section gives 663 tons more, which added to the 4,450 of the old ship, gives 5,113 for her new displacement. Admitting that in both cases the speed is 10·6,* and that the engines gave out 1,230 H.P. of 75 kilogrammetres, in both cases it is 12·46 horses per square metre; but in one 3·618 tons are drawn by each horse, and in the other 4·157 tons. At that speed the ship was burning 54 tons a day—viz., 2,500 kilogrammetres an hour, that is 25 kilogrammetres to force 1 square metre through water at 10·6 miles per hour, but 1 ton weight costs 0·562 kilogrammetres iu the small ship, and only 0·488 kilogrammetres in the enlarged one, that is a gain of 14 per cent. by the mere lengthening. This is the real profit, because *Eylau* had a good efficiency (by MM. Bourgois and Mott's formula). She used 0·186 kilogrammetres in a calm, when *Fleurus* had 0·160 kilogrammetres at 9·7 knots; *Jean Bart*, 0·153 kilogrammetres, at 9·2 knots; *Algeziras*, 0·177 kilogrammetres at 9·8 knots, and *Napoleon*, 0·173 kilogrammetres at 12·0 knots.

From this fact, some would perhaps conclude that lengthening in the middle without sharpening extremities, is a cause of better speed, but it is probably owing to the energy of impulsion of her engines with equilibriated cranks, as found when the engine was tried with the dynamometer at the fixed point on shore.

Now if we look to the economical utilization, that is to say, to the quantity of coal burnt in one hour, we remark that according to midship sections the result is 470 for both ships, and that with $D^{\frac{2}{3}}$ they have 128·8 for the old one, and 141·4 for the new. These examples, and many others, would show that by using $D^{\frac{2}{3}}$ we have a correct estimate of the duty performed by a ship, and it will be enough to look at the numbers in the tables and positions of various points in Plate I., representing the economical efficiencies of various ships of the Imperial uavy and Messageries Impériales, which show a great variety of results; and, notwithstanding this, it is to be remarked how the efficiency increases with the size of ships, especially when calculated with displacemeut.

It is easy to conclude the merits of ships of the same size, as of *Algeziras*, *Napoleon*, and *Arcole*, where the utilisation of the first is double that of the last. The old paddle frigates show the same difference with the packets of the Messagerie, and in the lower part of the Plate stronger differences are proofs of the high influence of skilful mauagement and good care. To sbow this, lines are traced from the best and worst results of large ships to the same of smaller ones, and aloug or beside these lines ships are placed according to their true merit.

The utilisation of economy, as calculated with the midship section, are on the left of the first Plate, and present interesting comparisons with those calculated according to $D^{\frac{2}{3}}$. The comparison of the packet boats of the *Messageries*, the *Simois*, *Mersey*, *Mitidjah*, and others, of 220 H.P., built by Moissard, show these differences, inasmuch as their length is $7\frac{1}{2}$ times their breadth, whilst the old ones have only 5·88. Some curious results may be obtained by comparisons of this kind with a number of ships of various proportions.

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* In all this work speed is always counted in knots, or nautical miles.

The three methods, of which the economy will have to be considered, show, that whether according to $D^{\frac{2}{3}}$ or by the midship section, the large ship is far superior to the small one.

A similar method will not suit for general comparisons, because a true measure will not be influenced by the greater or less size of the objects to which it relates.

The utility of such a general measure led Admiral Paris to try and discover if, in the general dimensions of a ship, there could not be found a correction, if it may be so termed, for the curve of M. Le Bouleur, which, when applied to the economic efficiency, might reduce them to a common measure. He has not yet obtained it, because of the anomalies which have arisen from the state of the boilers, firing, &c., but he prefers the theoretic curve, such as Mr. Bourgois has traced in the last work he published on the "Resistances des Carênes." This curve is represented by M G in the Plate II., and it is from this that he has deduced the theoretic economy as shown by the scales at the top and bottom of the Plate. For greater facility he has multiplied them by 1,000, and they are found in the following Table, in columns 2 and 5. Then, admitting that the distance to the point M expressed the beam of the largest ship *Bretagne*, all other beams were marked by this sign (.), and the dotted curve traced. As it is seen, this one has but a little difference with the first one, and subsequently on dividing the efficiency by the beam a constant number was to be obtained, and procured a true comparison. But as the theoretical efficiency is a fraction, it has been multiplied by thousands, and after that divided by the beam, the results being the line A B.

(*To be continued.*)

THE BAROMETER AS AN ENGINEERING INSTRUMENT.

By JOHN M. RICHARDSON, B.S.*

ONE of the first duties of an engineer after taking charge of any proposed line of railway, plank road, or canal, is to make himself thoroughly acquainted with the physical features of the country between the termini of the same. He should know every forest and cultivated field, every mountain and plain, every river and rivulet, every valley, and every range of hills. All these should be as indelibly engraved upon his mind as upon a map. Indeed, he should be as familiar with every feature of the country over or through which the improvement is to run, "*as though he had passed his hand over every foot of it.*" Such precise information can only be gained by a close and careful instrumental survey, using for that purpose the level, chain, and compass. These surveys, however, are very expensive, costing both time and money; and as several routes are usually surveyed, whilst only one is finally adopted, it follows, that if any feasible method can be suggested whereby the number of these surveys may be diminished there will be a great saving of both the important elements, time and money; or, since in this utilitarian and practical age, time is money, the saving may be regarded as one of money alone.

It is firmly believed that a proper use of the barometer in all reconnoissances will lessen the number of experimental lines usually surveyed, facilitate the location of the road or canal, hasten its construction, and thus confer a benefit upon the public.

Before setting any survey on foot, it is the usual custom for the chief to pass over the proposed line and examine it with the eye alone, selecting "guiding" or "ruling" points through which the road must pass, and gaining all possible information with regard to the country from the inhabitants along the route. The knowledge thus obtained is of great importance, and its benefit is felt when the more careful and accurate observers, the level and chain, follow after, noting with the utmost minuteness every change of grade. But the eye is a very unsafe engineering instrument, and should not be too implicitly relied upon when used without the aids which science and art have given it. It is true that by long practice some can judge pretty correctly as to the distance of two objects apart, or as to their relative difference of level, so long as they both remain in sight; but when space, and forests, and mountains intervene between two stations, A and B—especially if there be a succession of ascents and descents between the two—an engineer, aided by the eye alone, cannot say with any certainty when he has arrived at B, "I am below A," or "I am above A," except in one case, viz.: when he has been following the course of a stream. In confirmation of this, two facts will be detailed. The writer was once travelling over a very rough and broken portion of country in company with an experienced and distinguished engineer; they passed from the valley of one stream to that of another nearly parallel to the first, and at about right angles to their direction. The road along which they journeyed ran over a succession of ranges of hills, so that they kept ascending and descending; but as far as they could judge, the ascents and descents appeared to balance each other; and when they arrived at the second stream, they thought they were about on a level with the one they had left. Upon examination, however, the difference of level of the two streams proved to be over 200 ft.! The engineer alluded to (who was formerly an officer in the U. S. A., and who is well known as an able topographer and skilful engineer) exclaimed vehemently against the reliance of engineers upon the unaided eye in reconnoissances of long lines. The second fact is quoted from Lieut. R. S. Williamson's "Report" of explorations made by him in California, to aid in solving the problem relative to the practicability of the "Pacific Railroad." This Report will be referred to hereafter, though enough will be extracted now to answer another as well as the present purpose.

I will now give the results of the survey, merely mentioning here that the profile, as determined by the spirit-level and barometer, agreed remarkably well.

"From the Depôt Camp to the point where the Tejon Creek debouched from the mountains was a distance of $2\frac{8}{10}$ miles, over unbroken ground. *To the eye this appeared very slightly deviating from horizontality. The level showed a difference of altitude of* 483 *ft., giving a grade of* 173 *ft. to the mile.* The barometer made the difference of level 15 ft. greater. *I was surprised at this result, which taught that very erroneous impressions must generally be conceived with regard to differences of level if the eye alone is trusted to.*"

The use of the barometer will prevent the occurrence of any such errors, and it is probable that they are numerous. By it the level of one gap in a range of hills or chain of mountains can be compared with that of another, and thus the comparative ease or difficulty of connecting the contiguous plains or valleys by passing through one or the other, ascertained in the shortest possible time, and with the least expense. If merely examined *par un coup d'œil* in the reconnoissance, experimental lines must be run through both gaps, and the two routes can only be compared, their relative merits and demerits ascertained, after a long, laborious, and expensive instrumental survey.

By using the barometer, the chief, after his reconnoissance, can say, with almost absolute certainty in any case, which terminus is above the other, which is the highest point along the route, which the lowest, and where the greatest difficulties are to be encountered. The barometer does not, indeed, give horizontal distances, but in determining the practicability of any proposed route, *they* are of subordinate importance compared with differences of elevation. A pedestrian, a carriage, a locomotive, can accomplish horizontal distances with ease, but they cannot so easily ascend and descend hills and mountains. "These are the chief obstacles to the construction of roads and canals, and are the natural enemies of the engineer." By using the barometer, he does not lessen their hostility to his improvements, but he discovers in the most expeditious manner where they are weakest, and where he can best attack and most easily overcome them. This is all that is claimed for the barometer as an engineering instrument; and it is enough. Its results are not so correct as those of the level. They are only approximations. It goes before, and, as it were, sketches out the work, gives the outline; the level follows after and completes the picture. But by means of the sketch which the barometer furnishes the level, the latter is enabled to accomplish its work in much less time, and at a vastly diminished expense. Up to the present time the barometer has been chiefly used by travellers in determining the approximate altitudes of mountains, by chemists in ascertaining the specific gravity of gases, and by mariners as a weather glass. Its utility as an engineering instrument has been recognised practically but by few, either in this country or in England; on the continent of Europe it has been (such is the writer's information) more extensively employed.

The recent "Pacific Railroad Surveys," instituted and carried out by the General Government, have been instrumental in calling the attention of engineers more particularly to the barometer, and have demonstrated beyond the shadow of a doubt, its great value as an engineering instrument, particularly where the reconnoissance extends over long lines, and where there are, anywhere along the line, considerable changes of level.

The reports of the surveys alluded to, and more particularly that of Lieut. Williamson, afford much valuable information on this subject. Lieut. W., as already quoted, states that the profiles "determined by the spirit level and barometer agreed remarkably well." This is important as bearing upon the relative accuracy of the level and barometer. It will be well, however, to examine in some little detail the comparisons made between the level and barometer by Lieut. W. In the remarks already quoted, he states that the difference of elevation between two points as determined by the level is 483 ft.; as determined by the barometer, 498 ft. *Assuming that the result given by the level is absolutely correct*, the error, in that particular case of the barometer, is 15 ft., or + ·031056 of the whole, or—·030120 of its own determination. The result of this comparison is, that the barometric difference of altitude of two stations must be diminished by about three-hundredths of itself to get the true difference of altitude.

Denoting by H the true, and h the barometric difference of level of two places.

$$H = h\,(1 - \cdot03012) = \cdot96988\,h \qquad (1)$$

(1) is the result of a single comparison only, and of course cannot be relied upon unless it is confirmed by others. It is proposed to examine the other comparisons made by Lieut. W., and, rejecting only those

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* Extracted from the "Journal of the Franklin Institute."

which are obviously or probably incorrect, to determine the mean error of the barometer according to his observations. If the result thus ascertained is confirmed by other and more extended observations and comparisons, it can be relied on with more confidence.

Table I.—*Tejon Ravine.*

Level. (1)	Altitudes. (2)	Barometer. (3)	Altitudes. (4)	Differences. (5)	Per cent. (6)
— 2·1	2333·0	....	2327·3	5·7	·002449
— 39·0	2294·0	1.4	2328·7	—34·7	—·014901
—164·2	2129·8	—127·5	2201·2	—71·4	—·032433
—392·8	1737·0	—401·3	1799·9	—62·9	—·034947
—352·6	1384·4	—411·1	1388·8	— 4·4	—·003168
—226·5	1157·9	—249·7	1139·1	18·8	·016504
—218·7	939·2	—224·4	914·7	24·5	·026784
—170·3	768·9	—180·6	734·1	34·8	·047405
—243·1	525·8	—270·9	463·2	62·6	·135146
—136·2	662·0	148·3	611·5	50·5	·082583
—173·1	488·9	—116·6	494·9	— 6·0	—·012124

Explanation of Table.—This table is taken from Appendix C. of Lieut. Williamson's Exploration. (See vol. v., "Explorations for a Railroad Route from the Mississippi River to the Pacific.")

Column (1) gives the level-altitude of each station above the preceding station; (2) the total level altitude of each station above an assumed station; (3) the barometer-altitude of each station above the preceding one; (4) the total height of each station as determined by barometer above the assumed one; (5) the difference between the corresponding numbers in (4) and (1), obtained by subtracting the numbers in (4) from the corresponding ones in (1); (6) the percentage of the barometric error, and is obtained by dividing the numbers in (5) by the corresponding ones in (4).

The mean result of this comparison is, that the barometer-difference of altitude is too small by + ·032597 of itself. Hence,

H = (1 + ·032597) *h* = 1·032597 *h*............... (2)

Comparing this with (1), it is seen that the errors are just the opposite of each other. Combining (1) and (2) the mean result is,

H = 1·0012385 *h* .... (3)

Table II.—Tejon Pass.

Level. (1)	Alts. (2)	Baro. (3)	Alts. (4)	Differences. (5)	(6)	Level. (1)	Alts. (2)	Barom. (3)	Alts. (4)	Differences, (5)	(6)
59·2	59·2	60·8	60·8	— 1·6	— 1·6	109·7	2405·7	125·2	2457·3	— 15·5	— 51·6
239·2	298·4	231·6	292·4	8·6	6·0	186·7	2592·4	191·4	2648·7	— 4·7	— 56·3
184·5	482·9	205·8	498·2	—21·3	—15·3	202·3	2794·7	122·5	2771·2	79·8	23·5
217·4	700·3	228·6	726·8	—11·2	—26·5	353·4	3148·	348·1	3119·3	5·3	28·8
217·4	700·3	216·7	714·8	0·7	—14·6	689·7	3837·8	797·7	3917·0	—108·0	— 79·2
165·2	865·5	202·3	917·2	—37·1	—51·7	—588·9	3248·9	—600·1	3316·0	11·2	— 67·1
77·9	943·4	39·1	956·3	38·8	—12·9	—147·6	3101·3	—121·7	3195·2	— 25·9	— 93·9
382·2	1325·[illegible]	408·9	1365·2	—26·7	—39·6	..	..	— 68·3	3126·9	..	..
182·1	1507·7	188·9	1554·1	— 6·8	—46·4	— 93·1	3008·2	— 88·5	3038·4	— 4·6	— 30·2
..	1471·8	..	1474·9	..	— 3·1	—290·4	2717·8	—220·1	2809·3	— 70·3	— 91·5
..	1471·8	..	1439·6	..	32·2	— 56·9	2660·9	— 24·7	2784·6	— 32·2	—123·7
..	1471·8	..	1411·3	..	60·5	—104·1	2556·8	—110·2	2674·4	6·1	—117·6
..	1471·8	..	1487·4	..	—15·6	—228·0	2328·8	—234·2	3440·2	6·2	—111·4
182·1	1507·7	..	1527·0	..	—19·3	—120·1	2208·7	—135·6	2304·6	15·5	— 95·9
106·5	1614·2	..	1644·0	..	—29·8	—112·0	2096·7	—121·1	2183·5	9·1	— 86·8
104·1	1718·3	82·7	1726·7	21·4	— 8·4	— 95·3	2001·4	— 69·0	2114·5	— 26·3	—113·1
577·7	2296·0	605·4	2332·1	—27·7	—36·1	— 60·6	1940·8	— 78·1	2036·4	17·5	— 95·6

Columns (1), (2), (3), (4), and (6) are copied from the table in the "Report." Column (6) is obtained by subtracting the numbers in (4) from the corresponding ones in (2); (5) by subtracting the numbers in (3) from the corresponding ones in (1).

The mean result is, that the barometer-altitude must be diminished by ·020999 of itself.

H = (1—·020999) *h*. = ·979001 *h* .... (4)

Combining (4) with (3),

H = ·990170 *h*.

Table III.—Cañada de los Uvas.

Level. (1)	Alts. (2)	Baro. (3)	Alts. (4)	Differences. (5)	(6)	Level. (1)	Alts. (2)	Barom. (3)	Alts. (4)	Differences. (5)	(6)
319·8	193·4	..	213·4	..	—20·0	246·1	2618·6	235·5	2673·8	— 10·6	— 55·2
190·9	384·3	190·3	403·7	0·6	—19·4	190·9	2809·5	194·9	2868·7	— 4·0	— 59·2
336·1	720·4	335·7	729·4	10·4	— 9·0	— 51·5	2728·0	— 74·7	2794·0	23·2	— 36·0
197·3	917·7	200·1	920·5	— 2·8	— 2·8	—322·8	2435·2	—333·1	2460·9	10·3	— 25·7
138·0	1055·8	152·0	1081·5	—14·0	—25·7	— 55·0	2280·2	—146·5	2314·4	91·5	— 34·2
102·8	1158·6	..	1205·3	..	—46·7	—148·8	2131·4	—170·0	2144·4	21·2	— 13·0
102·2	1260·8	65·7	1271·0	36·5	—10·2	— 63·0	2068·4	— 71·9	2072·5	8·9	— 4·1
126·2	1387·0	145·2	1416·2	—19·0	—29·2	—103·6	2172·0	117·7	2190·2	— 14·1	— 18·2
79·6	1466·6	65·8	1482·0	13·8	—15·4	—169·3	2002·7	—152·9	2037·3	— 16·4	— 34·6
161·4	1628·0	140·0	1622·0	21·4	6·0	— 93·0	1909·7	—100·5	1936·8	7·5	— 27·1
146·4	1774·4	147·6	1769·6	— 1·2	4·8	4·7	9114·4	30·8	1967·6	— 26·1	— 53·2
35·3	1809·7	38·9	1808·5	— 3·6	1·2	39·7	1874·7	55·1	1912·5	— 15·4	— 37·8
64·3	1874·0	52·6	1861·1	11·7	12·9	47·6	1922·3	71·0	1983·5	— 23·4	— 61·2
57·1	1931·1	68·5	1929·6	—11·1	1·5	— 52·7	1869·6	— 49·7	1933·8	— 3·0	— 64·2
36·6	1967·7	41·4	1971·0	— 4·8	— 3·3	— 51·9	1817·7	—108·6	1825·2	56·7	— 7·5
77·3	2045·0	58·0	2029·0	19·3	16·0	— 67·3	1750·0	— 52·5	1772·7	— 14·8	— 22·3
61·1	2160·0	106·2	2135·2	—45·1	24·8	— 71·9	1678·5	—133·5	1639·2	61·6	39·3
266·4	2372·5	303·1	2438·3	—36·7	—65·8						

The columns in Table III are the same as in II. The percentage is determined as before, by dividing the numbers in column (6) by the corresponding ones in (4). The mean result is —·006898. Hence,

H = (1—·006898) *h* = ·993102 *h*.................. (6)

Combining with (5),

H = ·9916365 *h* .... (7)

In the body of the Report, pages 23 and 24, are recorded two other observations, which give as a mean result + ·019331. Therefore,

H = (1 + ·019331) *h*. = 1·019331 *h*............ (8)

Combining with (7),

H = 1·00598375 *h*...................................... (9)

With regard to the three observations taken from the body of the "Report," pages 23 and 24, viz:—

Level 483.	Barometer 498.	Difference — 15.	Per cent, —·030120
" 2665.	" 2621.	" + 44.	" +·016787
" 1308.	" 1280.	" + 28.	" +·021875

It is proper to remark, that they do not appear in the tables extracted from the Appendix, and consequently they enter the calculations only once, as they should.

Formula (9) is the final result deduced from the observations of Lieut. W. It shows that the barometer-altitude is too small by ·00598375 of itself. For differences of level less than 1,000 ft. it will be almost inappreciable.

If (9) be combined with the result obtained from the reputed measurements of Black Mountain in North Carolina, the error will be diminished a little.

The following determinations of the height of that mountain have been going the rounds of the newspapers, and are presumed to be correct.

Barometer	6708 ft.	Prof. Mitchell, 1855
"	6709 "	" Guzot, 1856
Level	6711 "	Major Turner, 1857

(Mean of barometers 6708·5): difference + 2·5; per cent. +·000372.

H = 1·000372 *h*.. (10)

Combining with (9),

H = 1·003178 *h*.. (11)

If the above reputed measurements of the altitude of Black Mountain are the ones determined by the gentlemen whose names are attached to them, formula (10) is valuable.

The results are remarkable, and, as bearing upon the relative accuracy of level and barometer important. The altitude of the mountain was determined by means of the barometer at two different times, by two different observers, and, probably, with two different instruments. The results differ by *one foot.* The third determination was made by means of the Y-level, by a third observer, and at a different time. It exceeds the loss of the previous determinations by *three feet*, the greater by *two feet*, and their mean by *two and a half feet.* The names of the observers are a sufficient guarantee that every precaution was taken to insure the greatest possible accuracy.

A few such independent determinations of the altitude of the same point are of more value, perhaps, than a number of isolated observations made to determine the altitudes of different points by the same individual with the same instrument. And if scientific men, who have opportunity, will only multiply the observations with regard to the height of Black Mountain, the question with regard to the relative accuracy of level and barometer will be set at rest, at least for such high altitudes.

The report of Lieut. W. does not state what means were taken to secure the greatest accuracy, though it is presumed that every precaution was adopted. The survey appears to have been conducted thus: The party divided; one portion remained in camp and made hourly observations with the barometer; the other ran a line of levels along the route to be surveyed, and made hourly observations with the barometer also; the heights of those stations at which the levelling-party made barometer observations, as determined by the level and barometer, were then referred to the station in camp. The three tables extracted from the report, give the results of the three lines run to test the relative accuracy of the two instruments. The observations made with the barometer in camp and along the route were noted at the same instant, and thus the party carried out the instructions of Biot on that subject.

An examination of the tables will show that the difference between columns (2) and (4) are relatively much less than the differences between (1) and (3). By comparing columns (1) and (3), which give the level and barometer altitudes of the stations with respect to each other, the final error of the barometer is + ·003252. Hence,

H = 1·003252 *h* .... (12)

(12) agrees very well with (11). If their mean be taken,

H = 1·003215 *h* .... (13)

Between formulas (9), (10), (11), (12), and (13), there is but little difference, and none practically, unless *h* be considerable.

(*To be continued.*)

H. M. SCREW STEAM-SLOOP "ICARUS."

The trial of the *Icarus* screw-steam sloop took place down the river on Tuesday, the 21st December last. She left Woolwich dockyard at 10·25 a.m., and reached Gravesend at 12·12 with a strong tide against her; after which she made several runs with and against tide, at the measured mile Lower Hope, under the superintendence of the Woolwich authorities and Messrs Rennie, the constructors of her engines.

The average speed thus obtained was 10¼ knots. The engines indicated above 600 H.P., making from 90 to 94 revolutions per minute. There was no heating in any part, and the trial was highly satisfactory to all concerned.

The dimensions of the *Icarus* are as follows:

	Ft.	In.
Length between perpendiculars	151	0
Beam, extreme	29	1
Depth	15	10
Tonnage O. M	$577\frac{30}{94}$	

She was built at Deptford dockyard.

The engines are 150 H.P. collectively, by George Rennie and Sons, on their Patent Single Trunk principle.

BROWNING GUN-BARRELS, &c.

We have been asked several times by correspondents to furnish them with an accurate description of the process of browning gun-barrels followed in the Government Small-Arms Factory, and by the most celebrated barrel-browners in Birmingham and London.

All trades are said to have some highly-prized secret, or follow in some branch a carefully-guarded secret operation; now, the thoroughly successful practising of the art of browning gun-barrels appears to be considered just such a secret. By publishing what we, on the best possible authority, believe to be the very best process applied to gun-barrels, we believe we shall be doing a considerable benefit (beyond complying with the wishes of several correspondents) to the makers of a multitude of small articles which might with great advantage be thus treated, as a protection against weather and the rusting effect of handling and of ordinary exposure; we therefore now give the following receipt:—

The barrels have to be clean and bright, and entirely free from grease, to effect which they are rubbed with pounded lime. When perfectly clean they are rubbed with the following mixture, viz.:—

6 oz. spirits of wine, 6 oz. tincture of steel, 2 oz. corrosive sublimate, 6 oz. sweet spirits of nitre, 3 oz. nitric acid.

When rubbed with the above they are placed in a warm room twelve hours, and then rubbed until the rust produced by the mixture is removed. The mixture is again applied, and after standing six hours in the warm room a scratch-brush is employed to rub off the rust. Then the mixture and the scratch-brush is applied two or three times a day for four or five days. The barrel is then placed in (real) boiling water for three or four minutes, to destroy the farther effect of the mixture. It is then rubbed quite dry, and while still warm from the boiling-water, it is rubbed over with sweet oil. The operation of browning should be performed in a dry, warm room, at a temperature of 70°.

GEOLOGISTS' ASSOCIATION.

The number of members is now one hundred and seventy. Mr. Hyde Clarke has been invited to become a Vice-President of the Association, and has undertaken to deliver an address at St. Martin's Hall, on Tuesday evening, the 8th of February, at 7 o'clock, "On the Organisation of a Geological Survey by the members of the Association."

ASSOCIATION OF FOREMEN ENGINEERS.—DEATH OF THE CHAIRMAN.

We regret to have to announce the death of Mr. George Sheaves, the founder and first president of the Association of Foremen Engineers. Mr. Sheaves occupied the chair at the society's monthly meeting in December last, but on the very morning of the day fixed for that of January, he had ceased to live. Mr. Sheaves was for many years in the employ of Messrs. George and Sir John Rennie, where he acquired the esteem of his employers and of those under him. As a thoroughly practical mechanic his ability was well known, and for careful attention to arrangement and the detail of construction of works entrusted to his execution he had no equal. For the last ten years he occupied the post of manager for Messrs. Grissell, Regent's Canal Iron-works, and was there also universally respected. It will be difficult to fill adequately the void created by his removal, whether as foreman, or chairman of the Association. A host of friends and of workmen connected with the firm of which he was so valuable a servant attended the funeral of Mr. Sheaves, at Abney Park Cemetery, on Friday, the 14th ult.

ON COPPER SMELTING.

By Hyde Clarke, C.E.*

Copper smelting is of considerable importance in England, not only because we smelt our own Cornish and other ores, but because we have also a large business in smelting foreign ores and refining foreign copper, which gives us a great command of the trade in manufactured copper; so that, as well by our own advantages as the deficiencies of our neighbours, we obtain valuable results. Although the copper mines of England do not afford the rich ores of Lake Superior or the Burra Burra, they abound in low sulphuret ores, which are easily smelted; and with the benefit of very cheap fuel, we are able to undertake the smelting of the rich carbonate ores of other countries on better terms than they can do it themselves. Many countries, rich in copper, have dear or scarce fuel, and dear labour, and must import their bricks and furnace cements, and thus it is found better to export the ore to the fuel, than to import fuel and carry it to the ore. Rich ores, too, in many cases, are carbonates, which can be more conveniently smelted with the English sulphurets. Then, further, France, Belgium, and Holland are almost destitute of copper mines, so that the English have an opening there for manufactured copper, and compete in Central Europe with the Russian copper, or supply those countries with bar copper for refining.

With all these advantages, it is still to be questioned whether the English copper trade has reached its height, or is free from vicissitudes. To suit the circumstances of local business, a particular course of smelting by coal in reverberatory furnaces has been adopted; but this is not the most economical method, nor does it admit of the reduction of the lowest class of copper ores. It is quite possible, looking to the effective establishment of copper smelting in Chile, the United States, and Australia, to the abundant supply of rich copper ores abroad, and the competition of very cheap iron, that copper may be reduced in price, and thereby the working of the Cornish mines be threatened; but, on the other hand, if processes be adopted for the more economical reduction of copper, ores of lower produce or at lower rates can then be brought to market, and the reduction in price may be compensated. New combinations of copper, new alloys, as with silicium, will likewise open new sources of consumption.

At present copper smelting is a routine work, pursued on much the same plan as of old, and on the same general system in most of our works, followed out as a mechanical practice rather than as a scientific occupation; but the description of it is interesting, because it is continually undergoing modifications, which result in more economical working, without much affecting the general system. There are several accounts of copper smelting, among which are those by the late Mr. John Vivian, the head of the great smelting firm; by M. F. Le Play, one of the most eminent mining engineers in France, who has most minutely observed the processes; by Dr. Percy, before the British Association; by Professor Warington Smyth, at the School of Mines; by Mr. C. Low, who has introduced several improvements; by Mr. Napier, the author of great improvements in smelting; by Mr. John Arthur Phillips, a member of this society, and by a writer in the *Mining Journal*: but no account has been laid before this society, and I have therefore taken the opportunity, in contributing this account, to bring it up to the present day. It will be seen that in the main it will agree with the authorities referred to, but with the difference resulting from modifications which, formerly matters of theory and experiment, have now been more liberally adopted. There is, however, one inconvenience in such a paper,—that it does not admit of the minute details which are necessary to give a complete view of the processes. Thus, Le Play has devoted a volume to the subject, describing each operation as closely as he could; and so, too, my own materials have to be abridged to meet the space which is disposable. It is much to be regretted, however, that we have not in English a work on this subject as copious as Le Play's, with the requisite drawings on a large scale. To produce this, however, would require, as in his case, the aid of a government department.

The copper smelting trade began in Cornwall, and was thence removed to South Wales, which, until lately, remained its sole seat, as it is its chief seat; but Liverpool, having a great import of foreign and colonial copper ores and bar copper, has favoured the establishment of smelting works on the Mersey, and has a copper market, which is yearly growing in importance.

The classes of copper ores chiefly produced in this country are sulphurets, which are made to average about 9 per cent. in the works. As sulphuret ores are more convenient for working in reverberatory furnaces, the smelters of South Wales and Liverpool are able to treat the carbonate ores from abroad, which are richer in metal, but less tractable than the sulphurets of copper.

The process of sampling copper ores in most of the copper countries of the world is now determined by the Cornish practice, which has been introduced, or is worked by Cornish samplers, or by Welshmen trained under them. This process has been sufficiently described in works relating to mining, and provides for the ore of each mine or class being broken up about the size of a French walnut, or say ¾ in., and formed into a separate pile. It is desirable the pyramidal pile should not be more than about a yard high, and the slope of the sides the natural batter determined by the stuff. A small pile is cut through with the sampling spade in four sections, by trenches, of about 8 in. wide at the base. The pile is cut thus:—

a b
c d

but if a large pile, thus

a b c
d c f

or

a b c d
e f g h

In each section, as for instance that of a, two portions are taken with the shovel from bottom to top of the inner pieces of the section at each end. All these sixteen scrapings are brought together, forming so many vertical sections of the pile, and well mixed and ground up, being gradually reduced by dividing the mass into four,

a b,
c d

taking away

a
d

* Read at the Society of Arts.

and leaving only b and c, which are mixed and again divided into four, when the process is repeated till the whole produce of the sampling is brought to a manageable weight, from which the small samples for assay are taken, and likewise a drying sample, to ascertain the proportion of moisture in the ore.

Although a pile of copper ore under 100 tons is only divided into four, when above that quantity it is always further divided.

Copper regulus for sampling is broken to the same size as copper ore; but, on account of the greater value of the article, it is usual, unless the pile is a very small one, to divide it into six or more plots.

Argentiferous copper ore, or argentiferous copper regulus, is broken smaller, or even ground up, as there is a greater chance of variation in the average sample.

Abroad, where the ores are shipped in a rough state, and labour is not available for breaking up the ores, they are sampled by taking one bucket of ores in ten or twelve, and reducing these to a small sample by continued subdivision and subtraction, as in the case of the Cornish process.

In shipping ores from abroad for the English market, the qualities of ores in bulk are separated by matting on board; but the richer ores, as silver ores, are shipped in small hide bags, of local make, or in bags of sacking sent out from this country, and in which there is a considerable trade.

In sampling, much, with all the care that is taken, may be done by a little mechanical skill on the part of the sampler in handling and managing his shovel, and in taking and leaving richer bits of ore, which he knows by eye, to get such a sample as he wishes.

In the case of ores in all climates, or whether carried by land carriage or sea, there is always some proportion of moisture imbibed which affects the net weight, and is ascertained by a drying sample, which is tried in an oven and reduced to a dry state, the difference of moisture being taken as the difference of weight.

This is not always the true difference, as other portions are volatilised besides water, and the difference is in favour of the smelting. In hot countries, ores are affected by heavy night dews, and by the muleteers wetting the ores on crossing streams. Ores in ships generally imbibe moisture.

It is to be observed that the drying sample is taken at a different time from the assay sample. The maximum moisture of foreign ores imported into Swansea is stated by Messrs. Richardson and Co., the eminent ore agents of that town, and by other local authorities, as follows:—

Chile ores	28 drachms, or	6 to 11	per cent.
Cobre ores	36 ..	15	,,
Cuba precipitate	60 ..	25	,,
Rough Chile regulus ..	9 to 10	3 to 11	,,
Rough copper ores	12 ..	5	,,
Fine copper ores	22 ..	9	,,

The minimum moisture abroad is:—

Rough regulus........	1½ drachms, or	¾	,,
Rough ore	2 ..	1	,,
Fine ore	10 ..	4	,,

The process hereafter described is an ordinary course of working poor Cornish sulphurets mixed with rich foreign carbonates; the furnaces being about 14 ft. by 11 ft. inside dimensions.

1. Process of Calcining Ores.

The first course is to calcine the sulphurets, so as to get rid of some of the superfluous sulphur. There are many modes of effecting this. Where there is not a populous neighbourhood, the simplest mode, and one sufficiently effective, is to roast the ores in the open air in a pile with brushwood or small coal. This is done, for instance, in the Alten Works in Norway, belonging to the Alten and Quænangen Company.

In some works, the calcining furnace is much the same as the other furnaces. In others, it only varies by side-doors being provided for rabbling or spreading the charge over the hearth.

Messrs. Vivian, in some of their great works, use what are called baboons, an old form of calciner, fixed over the furnace, into which they discharge the calcined ore hot.

It is usual to make calciners with double beds, because, at a lower heat, if required, than for melting, the flame can, after being used on the lower bed of ore, be made to play on the upper floor or bed. A charge of ore is commonly laid on the top of the calciner in preparation for the upper bed.

Various plans have been suggested and tried for applying the spare heat of the smelting furnaces for calcining; but in England fuel is so cheap that it is preferred to burn coal rather than to resort to new and cumbrous arrangements. In many cases the wear and tear of the new furnaces would be more than the saving.

Under a calciner are vaults, called cubs, into which the calcined ore is let down and left to cool.

A calciner is sometimes very much larger in the floor than the other furnaces. Each charge put in a large calciner will be about four tons of ore fine dressed. It is first put on the top, and then passed in due course on to the upper floor, where the calciners are double. It is well spread over the floor, and about every four hours is turned over with a large rake, called a stirring rabble, introduced from the side-doors. In six hours it is passed to the lower hearth through holes in the floor. In the first six hours' treatment little more is done than to warm the ore preparatory to the further calcining, as little or no chemical change takes place.

In the lower tier or hearth the charge is commonly left six hours, and is stirred every two hours, but as it is not stirred previous to discharge, it is only stirred twice. A charge is therefore passed through every six hours, but the time will vary according to circumstances. When the calcined ore is discharged into the cub, it is often cooled by water being thrown on it, and it is wheeled away to a heap for mixing, but in some cases is passed on direct to the furnace.

In smaller calciners than those here referred to, or in those of older construction, the charge will not be more than three or three and a-half tons weight. A difference in weight of charge will be compensated by difference in the size of the grate and the quantity of fuel consumed, so that the dimensions of the calciners might properly be adjusted by the proportions of calcining to the total work done.

For calcining the quantity of ore here mentioned with four charges a day, about one ton per day of coal would be burned, or about a quarter of a ton per charge of ore, or very nearly 1 cwt. per ton of ore; but as Sunday is a slack day, and the calciners are kept in heat, the rough consumption in a week may be taken at 7 tons, the number of charges at 24, and the weight of ore at from 90 to 100 tons. The number of working weeks in a year is about 48, but may be increased to 50.

If the ore calcined be a sulphuret of 10 per cent., though it is seldom so high, its constitution will be about, say:—

Copper................................	10
Sulphur................................	15 to 20
Silicious matter........................	45 to 55
Iron..................................	20 to 25

About half the sulphur is expelled in the calciner or in the cubs, and a portion of oxygen is taken in and unites with the iron, and some chloride of sodium is obtained from the salt water thrown into the cubs.

Another class of ore may be thus composed:—

Copper................................	8
Sulphur................................	23
Silica	45
Iron	24

Mr. John Cameron, F.C.S., tabulates the results as follow:—

Original Form.		Converted into	
Sulphuret of copper	8 Copper. 2 Sulphur.	8 Copper.... 2 Sulphur...	Sub-sulphuret of copper.
Sesqui-sulphuret of iron ..	21 Sulphur. 24 Iron.	10 Sulphur..	Lost or replaced by
		5·40 Oxygen. 12 Iron.....	Sesqui-oxide of iron.
		11 Sulphur.. 12 Iron.....	Sesqui-sulphuret of iron
Silica.........	45	45 Silica.	

In working a calciner, three men are employed for the day and three for the night, each gang under the foremen of calciners. The men are paid by the watch, and not by the charge, the operation being one of unskilled labour, and not requiring to be stimulated by piece-work. The wages are from 14s. to 16s. per week. There is, in fact, no definite rule as to the state of the calcined ore, as it is not required to be exhausted of the sulphur, nor is any assay made to ascertain its condition.

II. Process.—Ore Furnace.

The second process is to put the calcined ore into an ore furnace.

The general form of a reverberatory furnace is about the same, and has remained so, from the earliest period of the establishment of copper smelting in this country by Sir C. Clerke. Some old drawings of Cornish furnaces are much the same in principle and general details as those of South Wales or Liverpool now. Further confirmation of this will be found in an interesting article on the early copper patents of Sir C. Clerke, in the *Mining Journal* of November, 27.

A furnace consists of a flat egg of the strongest fire-brick, supported by brickwork of ordinary bricks. Into this egg a large grate discharges the flame of a powerful fire, which passes along the upper inner surface of the egg, and is carried up a narrow throat or flue. At the bottom of the egg is laid the ore or metal to be operated upon. Such is the general structure of a furnace, but its details must be more closely examined.

It will be seen that its chief constituent parts are the grate, the furnace or hearth, and the flue.

The grate is a smaller structure added to the furnace at its back, open to the furnace on one side, and having on the three other sides walls, roofed in at the top and open to the ashpit at the bottom. The size of the grate is chiefly dependent on that of the furnace; but it is varied by different engineers. According to an able practical authority, Mr. Alfred Trueman, C.E., the area of the hearth of the furnace being about 154 sq. ft., the area of the grate will be from 17 to 19 ft. The depth is not of so much importance as is the area of incandescent coal which supplies the flame. On one side of the grate is an iron feeding-hole, called a teasing-pot, by which coal is thrown in. The grate is open to the furnace, but the communication is throttled by a thick wall called a bridge, which likewise forms the dividing wall between the grate and the furnace, and rises above the level of the hearth of the latter.

The ashpit under the grate allows the furnacemen to get down not only to remove the ash, but to rake the fire from beneath.

The furnace is of an oval or egg shape, but flat, and its capacity is diminished by sandbeds or bottoms. It consists, as already said, of a casing, which is formed of fire-bricks or silicious bricks, called the inside casing. The outer form of the furnace is, however, nearer to a square, and it is composed of less refractory bricks. This is called the outer casing, and the intervals between the inner and outer casings are filled in with old bricks.

On the hearth or floor of fire-bricks of the furnace, as already said, a bottom is raised for its protection. When a new furnace is started it has to be annealed. This is done by keeping up a fire in the grate for about a fortnight, with the doors of the furnace off. No bottom has yet been put in. The doors are put up, and the furnace tested with a few hours good heat, to see whether there are any flaws or air-holes. If found all right, and while the furnace is hot, a little slag, say sharp slag, is melted on the top of the bricks of the floor, say two inches in depth. Some sand is then thrown in gradually with the slag, the furnace being still in heat.

The first bottom is then put in, being fire-sand to the depth of about 18 in.

It is calcined for two hours, whereby the sand is consolidated, and the specific gravity increased. The men then level it with a rabble. The bottom is then smoothed down with a beater, giving it a little fall to the tap-hole. The doors are then put up, and a strong heat is kept up for twelve hours. A little metal or ore is next thrown in, which is melted in, say, a quarter of an hour.

The sand is then thrown in for a second bottom, to a depth of, say, 4 to 5 in., and this is calcined for four hours. It is then levelled with the rabble and smoothed down with the beater as before; the doors are put up, and the bottom is melted for ten hours, and next the doors are taken down, and some metal is put on and melted for, say, half an hour. The doors are taken down and the furnace cooled black, that is, to a dull red heat, for three or four hours, when a full charge is put in and melted, and the furnace is cooled down again, and next three charges are melted in succession. The furnace is cooled down again, and thenceforth thoroughly started.

The bottoms constitute one of the most essential details in the working of a furnace. In South Wales blown sand (or sand driven on the shore by the wind) is used, because it is nearest at hand and readily obtained. As much as seventy waggon loads a day are used by some works. This sand is inferior, because it is mixed with shells consisting of lime, which flux; but it is supposed that in the blown sand the shells, being lighter, are winnowed, and that the proportion of silex is larger.

Abroad shore-sand cannot be used, and fire-sand is imported from England. Fire-sand is likewise employed in some of the Welsh works. Such sands are found in several parts of South Wales, near Swansea and Neath.

This fire-sand is nearly silicious; but shore-sand, blown, is thus composed, according to one analysis:—

Quartz and silica	86
Lime	5·7
Magnesia	·8
Alumina	1·6
Oxide of iron	1·2
Carbonic acid, traces of water, &c.	4·5

The following are notes on some fine sands, obtained inland, and used for bottoms:—

No I.—Cwm Joy, near Swansea.

Silica	92	Iron and lime	11

This proved very bad, and, while used, came up almost every week.

No. II.—Sand from near Briton Ferry and Neath.

Silica	92	Iron and lime	8

This did well.

No. III.—Pembre.

Silica	93	Iron and lime	7

This worked very well.

Iron is considered more objectionable in bottom sands than lime.

The consumption of the best fire-bricks yearly, in a furnace of the size recorded, including grates, will be between 7,000 and 7,500.

A single furnace, of the size already given, and a stack 45 ft. high, used up—

Best Welsh fire-brick	2,288
„ Scotch „	5,816
Common Welsh fire-brick	13,271
	21,375

The bottoms in an ore furnace will often last twelve months, but in a like furnace seven bottoms have been put in in the same time. The only cause assigned for this latter case was, that a stream of air came in through a hole in a door, and regularly cut the bottom, which parted and came up. In a roaster, however, the bottoms are always giving trouble. It is always desirable to keep the lower bottom as long as possible, and only to replace it when the furnace is out, or repairs are on hand. The lower bottoms may be worked for years. The upper bottoms may, however, require renewal in three days or in three months. The breaking of a bottom suspends the furnace for some time, as it has to be cut to pieces with flowing bars, and got up. Letting out a furnace only for a day causes such injury to the bottoms that they sometimes have to be removed or renewed. This will happen at stock-taking, when the furnaces are let down. This is one inducement to keep a furnace always under fire.

These bottoms absorb a considerable quantity of copper, which is thereby kept locked up in the furnace, and this prevents the double disadvantage of dead capital and of uncertain quantity.

The furnace requires a bin or hopper at the top, to put in the charge of ore, and has a tap-hole formed at one side, which is only opened for letting out the molten regulus. The front door, for stirring and rabbling, will be described with the flue.

The outside casings of the grate and furnace are not dependent solely on the cohesion of the bricks, of which the fire-bricks are cemented with fire-clay and fire-sand, but they are fastened by cast-iron studs or upright posts of iron, a foot or two apart, and bound together at top by bars of iron, called cramps, or clamps. Thus, a furnace is bound together in an iron cage, but it does not, nevertheless, withstand the violent action of the fire.

The flue springs from the narrow front of the furnace by what is called the uptake, up which the flame proceeds, and the flame and smoke are thence carried to a short stack or down into the central culvert. The front door of the furnace is under this flue in the front wall, and when the furnace is at work, it is secured by a door or slab of fire-pottery, which can be removed to enable the smelter to work the charge.

The grate is, as stated, a square, hollow chamber. It has at the bottom two strong iron bars or sleepers. Regular furnace bars are not used, but loose bars of old iron are laid on the sleepers. The place of furnace bars is really supplied by a clinker bed. The coals commonly used for smelting in South Wales, erroneously described in most works as anthracite steam coal, include a considerable proportion of clinker, and advantage is taken of this to build up a porous red-hot substratum of clinker, by leaving always a considerable portion of clinker in the grate. On the top of this the coal is burnt, and the height of the clinker grate is kept down by getting out portions from below the ashpit, and more particularly when a large clinker has been formed. It is for this reason that loose bars are used.

This clinker grate is porous, and has channels through it, up which the atmospheric air passes, and is heated before reaching the burning coal in passing thence to the furnace. When needful for this purpose the clinker grate is opened up with a pricking bar from below. This method has one disadvantage, that small coal will run through a large channel without being consumed, but are wasted in the ashpit. This may be remedied by greater care.

One advantage of this method is that almost any kind of coal or slack may be used for smelting. Generally the coal is the refuse of the collieries, if any vend can be got for the larger coal, and slack has been exported for foreign collieries. Any free burning coal will do, if cheap enough, but if used alone it is rapidly burnt up. It will be seen that the coal has to perform a double function,—to pour flame into the furnace, and to keep up the clinker grate; and therefore, where it can be done, it is found most useful to mix a free burning and a binding coal, so that the latter may clinker and bind together, besides giving its share towards the combustion. A coal altogether binding can be worked, but is not found good. Anthracite does not work well. A good mixture is one of binding and two of free burning.

The best coals—binding and free burning—are, perhaps, those of South Wales. Newcastle has good free burning and some binding; the Lancashire coals are inferior. Artificial fuel has been used, but there is a prejudice against it, as the men do not like to handle large blocks or large coals, but like to have them ready broken.

In our works the supply is mostly obtained from collieries leased by the copper companies; and as the best qualities are sold for shipment, the smaller coal comes cheap, and but comparatively little attention is paid to its quality or consumption. There is most frequently no choice as to quality, and it is so cheap that its consumption is not closely supervised. It is, however, very doubtful whether slack is really economical, for good coal forms smaller clinkers, having less refuse in it, and is more economical of coal; whereas small coal and slack form very great clinkers, and interfere with the healthy working of the furnace. With good coal the fire is pricked about twice in each watch, but with bad coal oftener.

With regard to the square form of grate, my opinion is that there is a space not fully occupied by the fire, which is lost, besides the grate being there liable to injury; and in 1855 I suggested that the back should be rounded, and this has been tried.

In working the ore furnace, the charge will vary according to the class of ores and the furnaces, and the weight, according to the size of the furnace, from 3 to 3½ tons, or in large furnaces rather above, but dependent on the fusible proportions of the ore. Calcined ores are more favourable, but the practice is at this stage to introduce raw carbonates, so that the following will give a good specimen of a charge:—

Calcined ore	36 cwts.	Raw ore 26 cwts.
Sharp slag	8 „	
Total	44	
Add	26	
	70	

The proportions of sharp slag may be made much higher, and, of course, that of calcined ore.

Of this total weight it is to be observed the slag is seldom weighed, but is computed; the ore is counted to the men as 22 cwt. to the ton: 2 cwt. in some works, and 1 cwt. in others is carried at once.

The mixture of the charges is one of the chief points in good smelting, and taxes the skill of the managers, for many classes of foreign ores are brought into our smelting works, and in some countries abroad a great variety of ores is found and smelted. In other countries, the quality of the ores is tolerably uniform, and the course of working is very regular. Where new ores are received, several trials may have to be made before the working is good, and sometimes the charge is worse at the end of the time than in the beginning.

In the early stages of copper smelting, the object of the manager is less directed to any operation on the copper—to the manufacture of copper, in fact—than to the manufacture of slag; for the removal of silex depends on a good silicate of iron being formed, which will freely flow out separate from the regulus. This is an essential point to bear in mind, for the slag may be pasty, and so carry off a portion of the metal; or it may be full of shots of copper, and so wasteful, while the object is to get rid of the silex with as small a quantity of the valuable article copper as may be. A good clean slag is, therefore, the satisfactory test of working, and the slags are anxiously examined by manager and men.

The charge of ore is put in through the bin or hopper at the top of the furnace, and is spread over the hearth, or rather bottom, with the rabble. The slag is thrown into the furnace through a side-door, in large lumps. All the doors are then luted on tight with fire-clay, and the charge is melted for about five hours, when the furnaceman starts his fire afresh.

About this time he begins the moulding of his metal beds, and his slag beds, which are formed of sand,—the metal beds near the tap-hole, and the slag beds before the fore-door. Any kind of common sand, dry, will do for these beds, as the moulding is rough.

Commonly about the end of five hours the furnaceman takes off the fore-door, which is burning hot, with an iron rod. He stirs the charge through the fore-door with a long rabble down to the bottom. If the charge is all right and thoroughly melted, he puts up the door and gives ten minutes for the metal to settle down to the bottom. The door is then taken down, and the slag is skimmed off with the skimming rabble through the fore-door into the slag-beds. The slag is run over the lower bar of the door, which is above the level of the bottom. The man can see the bright level surface of the metal, and observe by the eye whether it is clear of slag. It is his object to get the molten metal free from slag, and the slag free from copper; and more particularly as all slags found to contain more than an allowed portion of copper have to be smelted by him free of charge. These are the checks for good working.

The metal is tapped into the regulus into pigs, but not until there is enough regulus from several charges.

In this process it is sometimes necessary to add fluxes to the charge, as fluor spar, lime, shells, shelly sand, cinders, anthracite coal. Fluor spar is obtained from Cornwall, and M. Le Play estimated the consumption in South Wales at 7,800 tons yearly. At present some works use no spar, and others not more than 100 tons yearly. Shells are not used in this country, nor are carbonaceous fluxes esteemed.

Five charges can be put through a furnace in a day when the ore is good, and sometimes six. The work goes on night and day except on Sundays. The men are paid by the ton of ore in the charges, the ton being reckoned at 22 cwt.; the rate is now about 1s. 6d. per 22 cwt., or 2s. 9d. per 33 cwt., and a man's earnings are about 28s. per week. The men are one for the day and one for the night. The men of neighbouring furnaces help each other. The consumption of coal, working from four to five charges, will be from 25 to 30 tons per week.

The stuff put into the furnace will be, say—

Copper	$10\frac{1}{4}$
Silica	55 to 65
Iron	34 to 39
Sulphur	$7\frac{1}{2}$ to $10\frac{1}{2}$

The produce is—

Coarse Metal.

Copper	$10\frac{1}{4}$ to 11
Iron	$10\frac{1}{4}$ to 15
Sulphur	$10\frac{1}{4}$ to 7

Slag.

Silica	55 to 65
Iron	24 to 29

with a trace of antimony and tin.

The slag is a protosilicate of iron (34·62 protoxide of iron, and 65·38 of silica) with nodules of silex imbedded.

III. Calcining Powdered Regulus or Coarse Metal.

One of the old processes was to run the regulus or coarse metal not into beds, but into a basin of water or cistern, in which it was granulated. A part of Napier's improvements consisted in dispensing with this by a chemical mixture, but Mr. Alfred Trueman further improved by stamping the regulus to powder.

The powdered regulus is put into a calciner, which is the same as an ore calciner, and the general mode of treatment is the same.

The charge put in is from 3 tons to $3\frac{1}{2}$ tons, weighed out 2 cwt. at a time. The charge is put on to the roof, and so passed on to the floors. It is spread in the same way, and stirred every second hour. One charge is passed through in 24 hours, the calcining taking double the time of ore. At the end of the time, the regulus powder is cast into the cubs. Some sulphur is discharged in the cubs in vapour, which is passed through the cub dampers into the culvert.

The weekly consumption of coals is about 7 tons. Inferior coals may be used for calcining ore or metal. Bituminous coal will do for this.

Two men are employed for the day watch, 12 hours, and two for the night. Their pay is about 18s. to 20s. per week.

About six charges are passed through in a week; the powder calcined, being a regulus of, say—

33 copper,
33 iron,
33 sulphur,

has lost the greater part of its sulphur, and acquired oxygen, forming oxide of copper and oxide of iron.

IV. Melting Calcined Coarse Metal.

The furnace is the same as an ore furnace.

The charge is made up to a total weight of about 52 cwt. There is here an opportunity of introducing raw ore again as rich carbonates, and the following will represent a charge:—

Calcined powder	24 cwt.
Foreign raw ore	24 „
Refining, or roaster slag	4 „
Total	52 „

Another example is:—

Calcined powder	23 „
Foreign raw ore	24 „
Refining, or roaster slag	5 „
Total	52 „

Another example is:—

Calcined powder	20 „
Raw carbonates	20 „
Refining, or roaster slag	8 „
Total	48 „

Of these the charge may be made up with calcined powder and slag, and this is the case abroad; but English melters have to work up a great quantity of foreign ore, which they are thus able conveniently to introduce.

The ores in the charge are well mixed together in the ore-yard before being supplied to the men.

A charge is in about six hours, and is treated much in the same manner as in the ore furnace. The slag is skimmed in the same way, but the regulus, being more abundant, may be tapped every second charge.

The coal consumed is about 4 or 5 tons a day, or about 30 tons a week.

There is one man for the day watch, and one for the night watch. One furnace will pass through about 2,200 tons of ore, holding about 700 tons of copper.

The result is *blue* or *fine* metal and sharp slag.

The metal consists of,

Copper	70 to 83
Sulphur	30 to 17

The *sharp slag* consists of:—

Protosilicate of iron, with some copper and antimony.

The slag is so called because it is bright, breaking into sharp-edged fragments. They contain no shots inside, but small shots sometimes on the outside.

V. Process.—Roasting Fine Metal.

A roasting furnace or roaster is the same as an ore furnace, but has no bin, as it is charged by the side-door. There is an air-hole in each back corner, called a port-hole, which leads on to the furnace floor.

The charge put in is from 3 to $3\frac{1}{2}$ tons of metal, rough weight, or enough to produce $2\frac{1}{2}$ to 3 tons of copper. The charge is in about 24 hours. Each pig of metal is put in with a paddle. The port-holes are partially opened, and fire is gradually raised for the first eight hours, and the metal kept red-hot. The fire is then raised a little for another eight hours, so that the metal will sweat down. The port-holes are closed and the doors luted tight, when the fires are raised and driven on until the charge is thoroughly melted on the bottom. About the nineteenth or twentieth hour the front door is taken down, and the metal is stirred with a rabble. If all appears clean, the small quantity of rich slag produced is skimmed, and if the metal is clear it is tapped—if for export, as in foreign works, into iron moulds as pimpled bar copper, but if to be carried to refined, it is tapped into beds as pigs for the next roasting.

The quantity of coal consumed is from 22 to 25 tons per week.

The men's wages are about 3s. to 3s. 6d. per watch.

VI. Process.—Second Roasting.

When fuel is abundant and working careful, the metal is subjected to further treatment, and sometimes to a further roasting of twelve hours.

VII. or VIII. Process.—Refining.

The refinery furnace is the same in form as the ore furnace, but is smaller, and has no bin or tapping-hole, being charged from the side-door, and ladled out from the fore-door.

The charge in a refinery furnace will vary from five to six tons of pimpled copper in pigs. One charge is put in each day. The metal is melted fiercely for several hours and skimmed for the slight slag. Air is let in from the side-door till the copper begins to "work" or coil up, and when the refinery man, with a little rabble, moves or flaps the surface a little. The "working" is continued for two hours, when the copper is seen to "blister" or rise in black scales, having become blistered copper. The man keeps the side-door down, and lets the copper solidify according to circumstances, 2, 3, 5, 6, or 7 hours. The doors are then luted, and the metal melted afresh for three or four hours.

The head refiner now takes charge of the operations, and proceeds to take a small test in a ladle, which is worked into an ingot and tried on the anvil. If found fit, lead is put into the surface, about 16 lbs. to 6 tons of copper, and some charcoal is spread over the surface of the copper, and, further, the copper is stirred with a stout pole. He continues to test the copper, and as he finds the "pitch" or grain, so he backens or forwards the operation, and gives air or poles more.

The refined copper is cast into ingots, tiles, or wire bars, according to the demand. It is sometimes refined a second time, if "best select" is to be produced.

In making bar copper for sale on a large scale, it is a practice in some countries to mark the bar with the maker's name in the casting, and likewise the number of the charge, so that a quantity may be dealt with as of one make. Sometimes the number is punched.

Bar copper is sampled for sale according to a plan practised by Mr. Hussey Vivian, by drilling a hole, of from 1-8th to $\frac{1}{2}$-inch diameter, halfway through the bar from the top, and another halfway through from the bottom, but not so as to meet, as they make two half-sections, and thus afford a better average section. The drill is worked in a frame. The filings so obtained from each bar drilled are divided into four parts, *a*, *b*, *c*, and *d*; *a* and *d* going to the buyer, and *b* and *c*, as samples, to the seller, and from the total samples is taken, alternately, a check sample, under the seals of the buyer and seller.

The drilling is rapidly done. The quantity taken is about one drachm for each cwt., where the bars are of one charge or smelting, so that the total shall not be less than 240 drachms, or 1 lb. weight; all the drillings are well mixed together. The drilling from 4 cwt. would be 240 drachms, and from 16 tons of the same charge about 320 drachms.

The following is an analysis of select copper:—

Copper	99·80 to 99·85
Iron	0·10 to 0·15
Lead, Antimony	nil. nil.
Oxygen, Silver	of no consequence.

Select copper, as follows, will not sell:—

Copper	99·85
Iron	0·10
Antimony	0·01

or, even a trace of antimony.

The following is an analysis of the very best cake copper:—

Copper	99·60 to 99·70
Iron	0·10 to 0·15

Lead	0·10	to	0·15
Antimony	0·04	to	0·06
Silver	objectionable.		

The average consumption of coals to a ton of copper is about 10 to 15 tons per ton of pure copper, depending on the percentage of the ores and the goodness of the coal.

Mr. E. J. Cole, Secretary of the Alten Copper Company at Norway, and the Copiapo Company at Chile, who has been long connected with the smelting interest, has been kind enough to give me, for this Paper, some particulars of the working of copper in Norway.

"The following will give you some idea of the business at the Alten Copper Works:—

"The quantity of ore reduced in 1857 was $1,899\frac{822}{1000}$ tons, producing 123 tous of fine copper, the average quality being $6\frac{47}{100}$.

"1,874 tons, 036 ore, 402 tons, 600 metal slags, 19 tons, 000 sweepings,	Were reduced in the ore furnaces, and consumed 1,464 tons of coal.
418 tons regulus, 25,786 tons ore, 57,820 tons refinery and roaster slag, 73,800 tons furnace bottoms,	Were reduced in the metal furnace, and consumed $224\frac{1}{2}$ tons of coal.

212,500 tons white metal were roasted, and consumed 185 tons of coal.
128,000 tons black copper were refined, and consumed 34 tons of coal.

"You will thus see the process of reducing the ore to fine copper, and the consumption of coal in each reduction.

"The cost of coal, as you are aware, delivered at Alten, is about 12s. per ton. Some time ago we were able to secure freights very low, and we then had the coal delivered as low as 8s. to 9s. per ton. The great expense of reduciug ore is in the first process, where the largest quantity of coal is consumed, and when the ore is reduced to regulus. The after-processes are comparatively easy.

"The cost of reduction in 1857 was, per ton of ore, 28s.; per ton of copper, £21 12s.

"At Alten we fortunately have various descriptions of mineral, and are able to make good fusible mixtures; hence we obtain, as we consider, very satisfactory results, and our copper ranks equal to the best selected, and a good market is always obtained."

Furnaces.

A double-bedded single calciner, 30 ft. long over casings, exclusive of grate, and 14 ft. wide, will require, besides the bricks of the stack or culvert, about 50,000 bricks, fire and inferior qualities, but in which old bricks can be worked up; 2 tons of best fire-clay, and 8 tons of common fire-clay; 80 bushels of lime; 120 bushels of sand; a small quantity of fire-sand; about 40 tons of stone for foundations (but this depends on circumstances); of sundry clay pottery, 200 or 300 soaps, and as many splits; 20 slabs and 20 bearers. The wages will be, mason 156 days, boy 156 days, labourer 48 days, besides head masons, and smith for the smith's work. The time in building will be about 20 days, exclusive of odd jobs in finishing off and setting the calciner going.

The ironwork for such a calciner, consisting of cramps, studs, door-frames, plates, bearing plates, sleepers, teasing-hole, sliding-frames, and slides, will vary, according to the mode of construction adopted in the several works. The smiths' time in fitting would be seven days, and a labourer seven days.

A single double-bedded calciner will take about 24,000 fire-bricks and 1,200 red bricks, 2 tons of best fire-clay, 8 tons of common clay, and other materials as before. The labour will be less, both of masons and smiths, in proportion to the difference of materials.

The grate will be about the same as the grate of a furnace of like dimensions.

The staek will be the same as for other furnaces, and its cost will be according to the system of stacks adopted.

Furnaces are worked with stacks according to various plans, depending on the circumstances of the works, or on the fancy of the owner, manager, or mason. Some work the furnaces with a stack for each pair of furnaces, and some have all the flues brought by an underground culvert to one central stack. In the Cwm Avon Copper Works of the Copper Miners' Company of England, there is not one stack on the premises, but all the furnaces communicate with one common culvert, which is carried for a distance of about a mile and a quarter up the side of a mountain, whence the smoke is carried up a stack 40 ft. high on the top, forming a conspicuous sight for miles around, and with a draft strong enough to carry a man up into the air. This volcano can be seen for a considerable distance on a clear night, and on a fine day from as far as Tenby. A man took a contract for clearing out this culvert on condition of having the culvert stuff for his remuneration, presuming that it contained the usual average of copper throughout, as a considerable quantity of copper goes up the stack. The contractor, however, made an unfortunate bargain, and abandoned his contract, as the chief stuff was sulphur and arsenic.

In some works a central stack and single stacks may likewise be found, but the balance of experience is not in favour of either system so as to secure its decided adoption. The objection to a central stack and long culvert is, that the draft of individual furnaces is sometimes interfered with, and therefore stacks for each furnace are by some preferred. The advantages claimed for the central stack and culvert are, that an inferior draft is obtained, and that the copper passing out of the furnace in fume is saved; it is certainly true, that in a single stack but little stuff is saved, whereas in a culvert there is always stuff containing copper which can be smelted.

Au objection taken to a central stack is, that it may interfere with the working iu case of repairs; but if there be one line of culvert running between the furnaces, and at each end of the culvert a high stack, then, by means of a brick partition set up in the culvert, the number of furnaces to each stack may from time to time be variously apportioned, particularly during the repair of end furnaces, then all the remaining furnaces may be put on one stack. The draft of a central stack will be affected by the greater or less number of furnaces working on it, and this is felt to be an inconvenience by the smelters.

One circumstance that will affect the height of stacks is the situation of the works. A number of high stacks belching forth sulphur and arsenic night and day destroy the vegetation of the neighbouring fields wherever the pestilent breath touches, the field being stripped of herbage, as if by locusts, and brought to the appearance of a bed of shingle. Copper works are, however, mostly situated in waste districts.

Much attention has been given to this evil, and the great waste of sulphur and other substances carried off in smoke, and many plans have been proposed for their recovery, but as yet no particular result has been obtained. There is no question that the loss is very considerable, forming part of that great waste of residuary matter which meets with too little attention in England.

A stack 50 ft. high, and with an inside lining of 50 ft., and outside lining of 30 ft., will, exclusive of foundations, require 3,100 fire-bricks for the inside lining, and 2,500 common red bricks for the outside; $2\frac{1}{2}$ tons of common fire-clay, to be used inside up to a height of 30 ft.; 20 bushels of lime, 40 bushels of sand, and a little fire-sand for mixing with the clay. The wages will be, mason 24 days, boy 24 days, and labourer 21 days, besides superintendence; the time in building will be 9 days. All this is exclusive of foundations, which vary according to situation.

Such a stack is rodded, or cramped with iron rods, for better security against the action of the furnace flames passing through, and there will be used 530 ft. —$\frac{5}{8} \times \frac{5}{3}$ square, for rods, 400 ft. $1\frac{1}{4} \times \frac{1}{4}$ flat for cramps, and 200 ft. 3 in. by $\frac{1}{4}$ flat for cramps, besides $\frac{1}{4}$ cwt. for wedges. The smith and his labourer's time will be 9 days.

The cost of a furnace will vary, according to its purpose, its situation, and its dimensions. The following is for a large reverberatory furnace:—Outside dimensions over casings, 22 ft. 6 in. length; 15 ft. width; add for grate 6 ft. 2 in length by 8 ft. 8 in width; height of casings, from the floor at the grate end, 5 ft. 11 in.; at the fore part, 4 ft. 6 in.; inside dimensions of furnace, 14 ft. length by 11 ft. width; thickness of inner and outer casings at the side, 2 ft.; of jambs and sides of grate, 2 ft. 1 in.; of back of grate, 9 in.

Such a furnace would require about 8,500 fire-bricks and 3,500 common red bricks, and about 3,000 old bricks might be used up; of fire-clay, best, 4 tons, and common 7 tons; of lime, 80 bushels; of sand, 120 bushels, and a small quantity of fire-sand; of pottery, 200 soaps or closers; 200 splits, 8 slabs of various dimensions, and 12 bearers, whole or in halves. The wages will be—mason 60 days, boy 60 days, labourer 60 days, exclusive of superintendence. Such a furnace can be built in ten days, exclusive of odd jobs and finishing off.

The ironwork for securing the furnace will be as follows:—*Wrought iron*, 260 ft. 1 × 1 square bar, 100 ft. $\frac{1}{8} \times \frac{1}{8}$ square bar, 100 ft. $\frac{3}{4} \times \frac{3}{4}$ square bar, 26 ft. $1\frac{1}{2} \times \frac{5}{8}$ flat, 100 ft. $1\frac{1}{4} \times \frac{1}{4}$ flat, 80 ft. 3 in. × $\frac{1}{4}$ in. flat; 8 ft. $1\frac{1}{2} \times 1\frac{1}{2}$ square bar; 4 studs 9 ft. long × 3 × 3 in.; 2 studs 5 ft. 6 × 3 in. × 3 in.; piece of wrought iron 5 ft. 3 in. × 3 in.; teasing-pot; stuff for wedges. *Cast iron*, 14 studs $6\frac{3}{4}$ ft. × 3 in. × 3 in.; 7 studs 6 ft. 3 in. × 3 in. × 3 in.; 12 studs $5\frac{1}{2}$ ft. × 3 in. × 3 in.; 1 bearing plate 6 ft. × 9 in. × 2 in.; 3 sleepers 6 ft. 4 in. × $4\frac{1}{2}$ in. × $2\frac{1}{2}$ in.; 1 bearing plate 7 ft. × 9 in. × by 2 in.; 1 concave or convex plate $7\frac{1}{2}$ ft. × by 30 × $3\frac{1}{2}$ and $1\frac{1}{2}$ in.; 2 fore-plates, 5 ft. × 20 in. × 3 aud $1\frac{1}{2}$ in.; 2 skimming plates, 3 ft. × 7 in. × 3 in., made in three plates each. The wages will be—smith, for fitting, 14 days, and his labourer 14 days. The particulars and dimensions of this ironwork will vary, according to the fancy of each manager.

In some of the latter works the furnaces are still found cased in a jacket of thick iron slabs, secured by the studs; but it is not a good plan, as defects in the brickwork cannot be so well seen, and air-holes may thereby escape notice; nor is the furnace stronger, cheaper, or more durable.

A furnace exposed to the intense heat of copper smelting is always in process of consumption, and its repairs are continual. The outside casings will last five years, which is about the longest life, but the inner portions are perpetually burnt up. A grate will last at the least eight weeks, at the longest thirteen weeks, so that there will be six grates in a year. The inside of an ore furnace, with repairs, will last from eighteen months to two years, but of a metal furnace only from nine to twelve months.

In a subject so extensive as this omissions are more likely to be noticed than what is described, but the commercial portion of the transactions is both important and considerable, and would require a Paper by itself; and it is the more deserving of notice because the profits of the copper business depend more on good trading than on manufacturing cleverness.

INSTITUTION OF CIVIL ENGINEERS.

December 14th, 1858.

Joseph Locke, Esq., M.P., President, in the Chair.

ANNUAL GENERAL MEETING.

The Report of the Council for the past Session, which was read, commenced by regretting that there had not been a general resumption of works of public utility and of private enterprise in the United Kingdom; a large proportion of the professional engagements being still in foreign countries, or in the British Colonies. In India the suspended works upon the different railways had been resumed, and it was fair to conclude would now be pushed forward with vigour. On the Continent but little progress had been made, except in the construction of branch lines. The opening of the Caen and Cherbourg Railway, constructed by Mr. Brassey (Assoc. Inst. C. E.) was mentioned, as on that occasion, Mr. Locke, M.P., the President of the Institution, who was the Engineer-in-chief of the line, had been raised to the grade of Officer of the Legion of Honour. The line traversed a rich and fertile district, inhabited by an enterprising and industrious race. The total length was 225 miles, and the works comprised about 4,500 yards of tunnelling, 70 bridges across rivers, and 310 road bridges.

The various Spanish railways in operation, or in progress of construction, were then noticed; and it was stated that, in Austria, the Lombardo-Venetian Company, under the able direction of M. Paulin Talabot, had united the majority of the principal lines, with a view to the ultimate formation of one comprehensive system, which would be one of the most considerable in Europe, as it would consist of nearly 1,900 miles of railway, connecting Austria, Hungary, and Southern Germany with Trieste and Italy, and extending in an unbroken line from Vienna to Milan, and from the Bavarian frontier to Florence.

In Piedmont, where railways were so early introduced, but little had been done for some time past, beyond completing to the foot of the mountains, on either side, the Victor Emmanuel line, and commencing the herculean task of tunnelling through the Alps. Meanwhile, it was proposed to construct a line of railway along the Cornice Road, bordering the Mediterranean, from Nice, to join the railway at Voltri and thence to Genoa, for the accommodation of the traffic between France and Piedmont until the Alpine tunnel should be completed. In Portugal, arrangements had been made, under the direction of Mr. Fowler (M. Inst. C. E.), by Sir Morton Peto, Bart. (Assoc. Inst. C. E.), for the immediate construction of a main line from Lisbon, through Coimbra to Oporto. In Russia, the Engineers of the Crédit Mobilier of France were pushing forward the vast network of lines comprehended within their scheme; and on the Riga and Dunaberg line, under Mr. Hawkshaw (V. P. Inst. C. E.), rapid progress was making by Mr. T. Jackson, the contractor. In the East, the Ottoman Railway between Smyrna and Aidin, under the direction of Mr. Edwin Clark (M. Inst. C. E.) and Mr. Meredith (M. Inst. C. E.), the consulting and the resident engineers, was being vigorously proceeded with; whilst the line from Cairo to Suez had just been completed by M. Mouchelet.

In the Southern Hemisphere, the Colony of Victoria might be referred to as making great advances in engineering works. Undertakings of considerable magnitude had been designed, some were in progress, and a few were completed. The most prominent of these were macadamised roads, railways, water-works, shipping wharfs, piers, and slips for heaving ships out of the water. The railway from Yarra Yarra Bridge to Sandhurst, with a deep water pier in Hobson's Bay, for ships of 500 tons burthen, was completed, and in full activity; although as costly, mile for mile, as the London and Greenwich Railway, it yielded a profit on the capital of 10 per cent. per annum. From this line a branch had been opened to St. Kilda, which was found to be of great convenience to the suburban and residential traffic, and a prolongation was about to be made to the Sandhurst Railway. The Geelong Railway had been opened to Williamstown, and had only been delayed from reaching Melbourne by the non-completion of the Government line to Williamstown. The Government lines required to maintain the intercourse with the distant parts of the colony were in progress, large contracts having already been let. The Yan Yean waterworks, for supplying the town of Melbourne, were finished; the water was collected in artificial reservoirs, and was conveyed through a system of pipes, 40 miles in length, to the town. As the town was not subdrained, the disposal of the waste water was even now a serious question, there being only 4 ft. tide in the Yarra Yarra River, which drained into Hobson's Bay, an almost tideless lake. At some future, and probably not very distant period, this would render the question of dealing with the sewage as difficult as that of London. The deep water piers and slips at Williamstown were in an advanced state of completion, and would be useful auxiliaries to the commercial marine resorting to Hobson's Bay. The system of macadamised roads, leading from Melbourne to Maryborough, Sandhurst, Castlemaine, Ballarat, and other important places, had been completed, in many cases under very difficult circumstances, but were now so efficient that travelling was almost as rapid and as convenient as on the English roads before the introduction of railways.

In reference to telegraph matters, it was stated that the attempt to lay the cable between Candia and Alexandria had, for the present, proved abortive, in consequence of a severe gale, which rendered it necessary to cut the cable, and to buoy it, when 228 miles had been payed out, in a depth of 1,400 fathoms. This proceeding was so successful, that the cable was fished up on the subsiding of the gale; but the insulation being apparently injured, it was not considered advisable to continue the operations during the present advanced season. Candia, Syra, Chio, and Cape Hellas, were, however, successfully connected by submarine cables, under the superintendence of Mr. Liddell. Another attempt had been made to establish submarine communication between this country and the United States. The English and American steam-ships, with their respective portions of the cable, commenced paying out about mid-channel, and, after some casualties, the shore-ends were landed; but, unfortunately, the insulation proved so defective that no intelligible messages could now be transmitted, and, on account of the advanced state of the season, all further attempts to remedy any defects were adjourned. The cable lost in 1855, and a portion of that lost in 1856, off Cape Spartiventi, Sardinia, had been recovered by Mr. Liddell and Mr. F. C. Webb (Assoc. Inst. C.E.). The Channel Islands were now put into telegraphic communication with the English coast by means of cables laid by Messrs. Newall and Co., from Portland to Alderney, and thence to Guernsey and to Jersey. A cable with four wires was laid down by Messrs. Glass, Elliot, and Co., from Dunwich to Zandvort, but the communication through it had been delayed by an accident, which occurred whilst endeavouring to repair one of the wires; and a cable with two wires had been successfully laid from the English coast to Emden likewise by Messrs. Glass, Elliot, and Co.

At home an important feature in the railway extensions in the vicinity of the metropolis was the Victoria station, Grosvenor Basin, Pimlico, under Mr. Fowler (M. Inst. C.E.) This site was peculiarly fitted for a railway, as from the previous formation of the roads and bridges the levels of the rails could be so arranged as to avoid interference, by inclined approaches, with the adjoining streets or properties, whilst affording extensive frontage upon wide streets, at present not encumbered with traffic. The works, including a bridge across the Thames, consisting of four arched spans of wrought iron of 175 ft. each, were now in progress.

One of the important hydraulic innovations of the past year had been the new mode of lifting ships, introduced by Mr. Edwin Clark (M. Inst. C.E.), and which had been successfully applied at the Victoria (London) Docks. The apparatus consisted of thirty-two hydraulic presses, with cross heads and suspension links, similar to those used in lifting the tubular girders of the Britannia bridge. These presses were arranged in two parallel rows, leaving between them a space to receive a gridiron, 320 ft. long and 60 ft. wide, in a depth of water of 27 ft. By an ingenious arrangement, the presses were enabled to act in three separate groups, so as either to act simultaneously upon the gridiron, or to lift one or more points; in order, if necessary, to give a certain extent of inclination to the body which was lifted. It was stated that the original cost of a system of docks of this description would only be about one-fifth of that of ordinary graving docks; the operations of lifting and lowering were very rapid, a vessel of 1,000 tons burthen only occupying the docks for about thirty-five minutes; and the facility for making the repairs was very great.

In supplying towns with water, the only important work of the past year was the South Staffordshire Waterworks. The object of this undertaking was to supply the towns and districts of Lichfield, Walsall, Wednesbury, West-bromwich, Tipton, and Dudley, where, hitherto, there had been a serious dearth of good water. The spot selected by Mr. J. R. Mc Clean (V. P. Inst. C.E.) for establishing the pumping engines, was at Lichfield, where, in addition to a large surface supply, taken above the contamination of any sewage, by sinking down to the sandstone rock, and driving a tunnel, upwards of a mile in length, an unlimited quantity of pure soft water was obtained. This was raised by a pair of James Watt and Co.'s powerful pumping engines, and forced through a 2 ft. main of cast-iron pipes to a single stand pipe, at Brownhills, whence the water proceeded by gravitation through the remainder of the main, 22 in. diameter, which was laid for a distance of nearly 14 miles, chiefly alongside the rails of the South Staffordshire railway, to the reservoirs at Walsall, Wednesbury, and Westbromwich, situated at the respective heights of 180 ft., 240 ft., and 260 ft. above the main at the engines. The total contents of the storage reservoirs was ninety million gallons. The ultimate length of the main-pipe would be upwards of 25 miles, and it was given as a remarkable instance of care, on the part of the Messrs. Cochrane and Co., the iron founders, and Mr. Aird, the contractor for laying them, that out of 7,000 pipes, only two should have exhibited any defect when laid, and these defects were each remedied within an hour.

The principal papers read during the session were then noticed; and it was remarked, that, as usual, the discussions occupied a longer time than the reading of the papers, and would be found to add greatly to the interest of the Minutes of Proceedings.

The members were strongly urged to continue to present copies of scientific and professional works for the library, without which its utility for reference and consultation could not be maintained.

Special attention was directed to a very interesting series of photographs of some important structures in the City of Washington, U. S. America, now in progress, or recently completed, under the direction of Captain Montgomery Meigs, U. S. Engineers, by whom the views were presented to the Institution.

The Washington aqueduct, the most important, though not the most costly of these works, was intended to supply the City of Washington with water from the great falls of the Potomac. The source was 150 ft. above the tide. The aqueduct was a circular conduit, generally built of rubble masonry, laid in hydraulic cement. The diameter was 9 ft. in the clear; the masonry being 14 in. in thickness. Its fall was 9 in. in 5,000 ft., and its discharge, at 8 ft. depth of water, was 67,596,000 American standard gallons in twenty-four hours. The lowest discharge of the river in summer droughts was 63,000 cubic ft. per minute; at its highest it was a flood like Niagara. There were eleven tunnels upon the line, of which two only were incomplete. Of the 12 miles of conduit, about half a mile remained to be executed. There were several bridges of masonry, including one elliptical arch of 75 ft. span, and one single granite arch, segmental in form, of 224 ft. span, crossing a ravine 100 ft. deep, with rock abutments. A bridge of 200 ft. span, of iron, crossed the creeks, between Washington and Georgetown; the iron pipes, 48 in. in diameter, doing duty as arched ribs to support the bridge, and also as mains to convey the water under pressure. They were lined with staves of wood, as a protection against frost. The reservoirs had a collective area of about 90 acres of water, and stored up many days' supply. The work was completed, except the dam, the second reservoir, the larger bridges, and two tunnels, one of which would be finished during this winter, and the other in July next. The bridges would probably be all completed by the 1st of August, 1859. The estimated original cost of the 7-ft. conduit was 1,921,000 dollars; of the 9-ft. conduit, 2,300,000 dollars; and the probable cost, when finished, was estimated at 2,550,000 dollars. The masonry aqueduct was 12 miles long. The pipes to be laid, by the Government, to the public buildings, navy yards, &c., would cost about 400,000 dollars.

The Capitol of the United States was a building 750 ft. in length, and 70 ft. in height. The centre was looked upon in America as an old building, having been built about thirty years. It was of sandstone. The wings, upon which Captain Meigs was now engaged, were faced with blocks of white marble, slightly veined with blue, but not sufficiently coloured to affect the appearance, at a short distance. In this building were the Halls of Congress. The Hall of Representatives, in the south wing, was 139 ft. long, 93 ft. wide, and 36 ft. high. In it the voice of any ordinary speaker was said to be audible, without effort, in every part of the room, and this without regard to the place from which the orator addressed the audience. Its ventilation was satisfactory, and throughout the variable winter there were no complaints of too much cold.

The north wing would be occupied this winter. The porticoes yet remained to be erected. The centre building was crowned by a dome, partly of brick and partly of wood, modelled after that of the Pantheon at Rome. The portico of this building was also a copy from the Pantheon, but raised upon a basement, with a noble flight of steps in front. The old dome had been removed, and some progress had been made in erecting the new one, which was of iron, 300 ft. in height; the diameter of the peristyle being 124 ft. 6 in. The cost of the old building of the Capitol was about three million dollars; the new wings would cost between five and six million dollars, and the dome nearly one million dollars.

The Post-office building was of white marble. The columns were monolithic, from Carrara. The rest of the marble was similar to that in use at the Capitol.

The Washington Aqueduct was entirely under the direction of Captain Meigs, but in the architecture of the Capitol and the Post-office buildings he had the aid of Mr. Thomas U. Walter, who had been associated with him since he took charge of these two buildings. In the heating and ventilating of this building he had the assistance of Mr. Joseph Nason. These works involved a total expenditure of nearly ten millions of dollars. They were now drawing towards completion. The buildings were occupied; the porticoes and the dome remaining unfinished, and some interior decorations were still in progress.

The deceases of the members during the year were announced to have been—Rear-Admiral Sir F. Beaufort, honorary member; Messrs. R. Garrett, A. Grève, R. Hopkins, A. S. Jee, H. F. Mackworth, and J. Seaward, members; and Sir G. Cayley, Bart., and Messrs. T. W. B. Blakemore, M.P., and J. Hodgson, associates. The memoirs of these gentlemen were given in the Appendix to the Report. The resignations of four associates were announced, and it was stated that the effective increase during the year (after deducting the deceases and resignations) amounted to 22, whilst the total number on the books was 857 members of all classes.

The statement of the receipts and expenditure showed an increase of receipts and a diminished expenditure, and that there was a balance of upwards of £1,000 in the hands of the treasurer. The financial position was in every respect so satisfactory that the Council intended to apply a portion of the surplus funds to the improvement and extension of the library.

During the year the second part of vol. vii., and the whole of vol. xvi., of the Minutes of Proceedings, had been published and issued. There now only remained, to complete the series of seventeen volumes, extending over twenty-one years, the second part of vol. viii., and vol. xvii., for the past session, both of which were nearly ready for issue.

The Report concluded by congratulating the members on the general satisfactory state of the Institution, which to some few, still among them, had been, from its humble beginning in 1818, an object of solicitude. Ample funds, volumes of proceedings printed rapidly, well attended meetings and crowded *conversazioni*, were the outward signs of prosperity, but they also indicated the greater necessity for increased exertions on the part of all who would insure the permanent prosperity of an Institution which had done so much good, and might still continue to be so useful, if it was adequately supported by the members of a profession which took no mean part in the labours of the present century.

After the reading of the Report, Telford Medals were presented to Messrs. J. A. Longridge, G. Robertson, J. Henderson, R. J. Hood, Maj.-Gen. G. B. Tremenheere, and A. Giles; Watt Medals to Messrs. G. L. Molesworth and T. S. Sawyer; Council Premiums of Books to Messrs. C. H. Brooks, F. C. Webb, S. A. Varley, R. C. Despard, A. Wright, and J. Brunlees; and the Manby Premium, in Books, to Mr. G. L. Molesworth.

The thanks of the Institution were unanimously voted to the President for his attention to the duties of his office; to the Vice-Presidents and other Members and Associates of Council, for their co-operation with the President, and constant attendance at the meetings; to Mr. C. Manby, Secretary, and to Mr. Forrest, Assistant Secretary, for the manner in which they had performed the duties of their offices; as also to the Auditors of the Accounts and the Scrutineers of the Ballot, for their services.

LITERARY AND PHILOSOPHICAL SOCIETY—MANCHESTER.

January 11th, 1859.

W. FAIRBAIRN, F.R.S., &c., President, in the chair.

THE PRESIDENT exhibited various specimens of the iron of certain locomotive boilers which had been found to have suffered local corrosion of a dangerous kind, after only a few years' work. The first specimen was from the boiler of the goods locomotive engine, *Goliath*, built by Messrs. Hick and Son in 1839. It was a part of the fire-box, through which one of the longitudinal stays had passed. The iron (Low Moor) had been cut away by the corrosive action in grooves radiating from the stay as a centre. The second specimen, taken from the same engine, and likewise of Low Moor iron, was from a part which had been rent asunder in the explosion of the boiler in 1847, before the engine was nine years old. A third specimen was from the boiler of the *Bat* goods locomotive, built by Mr. Woods. It consisted of a part of the angle-iron ring at the smoke-box end. A deep groove had been formed by the corrosive action, and water escaped through the angle iron after the engine had worked less than six years. A fourth specimen was taken from the passenger locomotive, *Ostrich*, built by the Liverpool and Manchester Railway Company. The bottom plate of this boiler, made of Low Moor iron, had been corroded in less than four years to such an extent that water escaped through it. The President observed that these remarkable effects belonged exclusively to locomotive boilers, and had not been noticed in those of stationary engines. He recommended the subject to the attention of the Society as one of scientific interest, as well as great practical importance, indicating, as it did, a source of hitherto unsuspected danger.

A lengthened conversation ensued, some members being of opinion that the phenomena were owing to the vibratory motion of the engine, predisposing certain parts to chemical action. Others thought that currents might exist in uniform directions, by which the part might be kept in that condition, as to cleanliness, most favourable to oxidation. Several members thought that the action was owing to galvanic currents arising from portions of the iron taking the electro-negative condition, which that metal is so apt to assume.

Professor ROSCOE called attention to the pernicious consequences attending the use of unglazed arsenical green paperhangings. His own experience corroborated the observation of Dr. Taylor, that dust collected in rooms so hung contained a large quantity of arsenic. He had analyzed the dust from the shelves, &c., of a room occupied by himself, and had found a considerable quantity of this poisonous substance.

Mr. DYER read a Paper ON IMPONDERABLE MATTER, CONSIDERED AS AN ELEMENT.

He stated, that about two years ago, his first Paper "On the Nature of Heat" was read before the Society, and he therein maintained that the "Matter of Heat" was not a misnomer, but, in fact, a material element, that pervaded all space and all bodies in the universe, and in its neutral state was identical with the *electrical* and *magnetic* fluids, as also with *light*, or the luminous principle.

Since then he had read three other Papers, to illustrate and explain his views of clemental heat, and its agency in phenomena, exhibited by its mutations from the elemental state, into and out of the conditions commonly expressed by the terms, sensible, radiating, and latent heat, the present Paper being intended to give a *summary* of the views advanced in the former. For the sake of brevity, his own is treated as a "heat-force theory," to denote its being opposed to the "force-heat theory;" and, considering that this latter theory has been advocated by many eminent philosophers among the ancients, as well as the moderns, it would be a great temerity in him to oppose that theory, unless he had some strong grounds of objection to offer to it, as well as those in support of his own views. In explanation of these, he said, the common terms applied to heat in its sensible, radiating, and latent states, do not apply to or convey the meaning he attaches to the term "neutral and elemental heat," which condition he defines to be "an imponderable elastic element" that permeates and is *equally* diffused through matter and space, except when its elastic force is exceeded by other disturbing *forces*. Many instances of such disturbing forces were set forth and explained, and in reference to these he observed, "that great confusion had arisen from the vague and discordant senses in which the term 'physical force' is often employed by very eminent physicists." In treating of the "nature" and "conservation" of force, the term is said to mean "that which produces or resists motion," thus implying that force is of itself a substantial existence, whereas it merely indicates *action* among bodies. These exert force upon one another, and upon their own component parts, so that force means exerted action of matter upon matter, and to give it substantial attributes is absurd.

In support of the identity of heat and electricity, many cases were cited.—(1.) That heat ascends latent in aqueous vapour, which, being condensed, the latent heat becomes neutral or elemental in the upper regions, and this *because* no substance is present, other than "the thin cold air" with which it can unite, and become sensible heat. This neutral element is the electric fluid, and is made known to us in all the forms of electrical phenomena.—(2.) Again, when water descends through the crevices of the earth down to the incandescent mass, it is converted into steam of great force, causing volcanic eruptions and earthquakes, according to the intensities of the forces so generated, by the union of water with heat. This heat latent in the vapour ascends and is liberated in the upper air, and flashes forth as lightning, always attending those convulsions and proving the identity of the calorific element with the electrical phenomena so exhibited. It was stated that his (Mr. Dyer's) heat-force theory was in strict accordance with Dr. Black's latent heat doctrine, and that it went to support it, and to explain some anomalous cases that had been adduced against the beautiful system of latent heat so long an established basis of wide ranges of phenomena, alike in nature and in art. Considering that the "force-heat theory" is inconsistent with Dr. Black's, and as this latter is embodied in most of the standard works on physics, it should not be abandoned to make way for another theory that fails to account for such phenomena. Apart from the mutations of heat from chemical changes, the mechanical action of the earth's movements was described as exhibiting magnetic and luminous phenomena, by the movements of elemental heat, proving these also to be identical with it, and with electricity. He then proceeded to show the sameness of light and heat, as proved by the many incontrovertible instances advanced of their inseparable connection, and mutual convertibility into each other; and thus finally arrived at the sole inference fairly to be drawn therefrom, namely, that heat and light, as also heat, electricity, and magnetism, are only so many different conditions in which the one calorific element exists in nature, and manifests itself by its mutations in phenomena.

Dr. Joule described the experiments he had made many years ago on the thermal effects of the dilation of elastic fluids, which he considered fatal to the doctrine of the materiality of heat. He called attention to the experiments which Mr. Dyer had made twenty years ago, indicating the possibility of generating heat by the agitation of water. These experiments, he believed, would prove to be of great interest to the history of science, and trusted that the author would be able to place them before the society.

CORRESPONDENCE.

[*We do not hold ourselves responsible for the opinions of our Correspondents.*]—Ed.

To the Editor of The Artizan.

Sir,—As you allowed Mr. Terry's letter to appear in your December Number, in which he states there were misrepresentatious in my answer to the review in No. 189, I trust you will admit the following, in order to prove on whom such a statement ought most truly to rest. Mr. Terry in his letter states—1st, "My invention is entirely different from any breech-loading principle patented, at home or abroad, previous to the date of my own." My patent is dated February 21st, 1855: Mr. Terry's, April 7, 1856. By referring to my specification you will find the following passage:—"The second part of my invention is a modification of the above, the barrel being a fixture, and the plug moveable. The plug forms the fore-part of a piston, which slides in the breech end of the barrel, which is elongated for that purpose. The piston is provided with a strong pin, or pins, passing through it, and working in bayonet slots in the breech end of the barrel. The pin forms a lever, or has a lever attached to it, and the slots are slightly inclined, as in the before-described arrangement, so that (having introduced the cartridge at the breech), upon pushing the piston forward, and giving it a slight turn, the plug will be wedged home firmly, and thus close the breech end of the barrel." This will answer Mr. Terry's first statement, as a more exact description could not be given of what is called "Terry's rifle." To his second observation, I can inform him, the barrels of my rifles, or guns, are proved twice—once before stocking, and a second time all complete, stock, lock, and barrel.

Mr Terry in his letter states—3rdly, "Mr. Prince must frequently use explosive paper, which, of course, is highly objectionable, because it is dangerous." The best reply I can give to the above is, that during the last 600 shots I have fired before officials I have only used common paper, and have only had one miss-fire, and no stoppage. I will also give an extract from a letter which I recently forwarded to General Peel:—"Sir,—A theoretical objection having been made to my breech-loading carbine, on the ground of the barrel moving, I beg respectfully to request your permission for one of the same to be put to the following practical test—viz., 20,000 or 30,000 rounds to be fired at the rate of 1,000 or 2,000 per day out of one carbine, without cleaning, and without 'lubricating with saliva,' &c. At the end of each day's shooting the carbine to be locked in a case and sealed up, and only to be again opened when the next day's shooting takes place, and then only on the ground, and in the presence of the officer or officers appointed to witness the trial. Should no rain occur during the same, a watering-pot on one or more days to be used, to test the capability of the arm resisting the effect of heavy rain, and remaining uncleaned afterwards; or the carbine might be thrown into a pond, and mud and gravel be shovelled over it, still it would continue in action. The cartridge also to be *practical* and cheap, and *made* in the *arsenal*, and to consist of *two folds* of common cartridge paper, and to be such as men could readily make in the field on an emergency: miss-fires would not average 3 in 1,000, with regulation caps." I must again join issue with Mr. Terry, as he states: "All these points herein mentioned are established officially, and open to public investigation." As far as the specifications are concerned they are so, but if the report of the Small Arm Committee is open to Mr. Terry, I doubt much if it is so to the public, while I myself am unacquainted with its contents. My assertion as to superiority in strength of shooting or penetration, as far as shot is concerned, I presume, is verified by the trial, in "Bell's Life," of January 23rd, and all I have not yet proved is the 400 yards extra range, and the capability of one of my rifles shutting up six of his,—common paper cartridges, unassisted with a felt wadding, being used with both arms. The trial alluded to above I extract verbatim: speaking of Terry's gun, the editor says: "At 30 yards its accuracy of shooting was fully equal to two muzzle loaders tried at same time with precisely the same charge, yet at greater distances, 40, 50, and 60 yards, its performances were so wanting in power that we could not judge of its capabilities of straight shooting. At 40 yards, shots from an old single-barrel 'Westley Richards,' of the same calibre, which had been in our possession many years, went completely through a thick pamphlet, peppering the page in every direction, while from Terry's gun, no shots in the many trials we made went completely through, and the majority did not penetrate more than two pages. At 50 yards the difference was still greater,—not more than seven or eight shots from Terry's gun striking the paper, while the old gun again sent a goodly number deep into the target—if such it could be called. A double-barrel by Prince, above alluded to, of twelve bore, with the same charge ($2\frac{1}{2}$ drs. of powder, and $1\frac{1}{4}$ oz. No. 7 shot), at this distance, however, completely riddled a similar target, and at 65 yards, with the same charge, also did better execution than either of the others at 50. At 65 yards we did not succeed in making our mark with Terry's breech-loader." Mr. Terry concludes his letter by an extraordinary statement. I extract it, and give my reply: "Mr. Prince, for reasons I suppose best known to himself, never allowed any body but himself to shoot his gun at all official trials at Hythe, Enfield, and Woolwich." Had Mr. Terry been present at Hythe when his carbine broke down at the third shot, he would have seen several hundred shots fired by private soldiers from my three carbines, one of which was used from day to day without cleaning. At the following trial, Mr. Terry, however, was himself present, and saw some 300 rounds fired from my carbines, by private soldiers only, until I urged on General Hay my wish to be allowed to show what my carbines would really do. The result was, a target of twenty shots at 300 yards averaging less than 9 in., and at 200 yards $6\frac{1}{32}$ in.,—the 300 yard shooting being better than any from Terry's carbine at 200 yards.

I have now gone through Mr. Terry's assertions. What grounds he had for making the same I leave your readers to judge, as also on whose shoulders the imputation of "barefaced misrepresentations" should rest. In conclusion, if Mr. Terry really is desirous of trying his arm against mine, on all or any of the points stated in my letter in your November Number, by addressing a note to me, at 138, New Bond Street, the trial can be arranged. After the public trial, in "The Field," last April, Mr. Terry stated his anxiety to retrieve the character of his rifle, his being the worst on the list at 200 yards, though shot by his son, his average being $30\frac{1}{4}$ in. His letter in "The Field," asking for a further trial of his rifle, concludes with the following paragraph:—"Hoping you will be able to offer such opportunity as speedily as possible, to prove my assertions by the evidence of facts." The Editor replies: "We shall be happy to see Mr. Terry shoot his rifle at any time." Nine months have elapsed without Mr. Terry having put in an appearance. The fair presumption is, that Mr. Terry has never yet been able to produce a rifle to make as low an average as mine then did, viz., $1\frac{3}{4}$ in. at 100 yards, and $4\frac{1}{8}$ in. at 200 yards. I am always prepared to shoot against the above score, and could, I think, generally beat it in favourable weather. Apologising for trespassing thus on your columns,

I am, Sir, yours repectfully, Fred. Prince.

To the Editor of The Artizan.

Sir,—Your correspondent, "G. J. Y.," in the November Number, has considerably mystified a very simple practical result, by getting entangled in uncertain theories.

In the paragraph, beginning "the falling stone," he appears to have taken it for granted that the falling weight was from everlasting time suspended *somewhere* over "Mercury, the dense water of the Dead Sea, the earth's atmosphere, or even the tenuous tail of a comet." Now, in all cases of falling weights applied to machinery, we must consider that the weight has first been raised through the same medium in which it is to fall whilst moving the machine.

A clock will illustrate my meaning: does "G. J. Y." doubt but that the weight in falling will exercise the same power on the clock as was expended in raising it, and that quite irrespective of *time*? The reason is obvious, for the weight was raised through air, contrary to the attraction of the earth; and it falls through air in obedience to the same influence. No "cube theory" should be dragged into such a case as this.

Ely. Yours obediently, H. T. D.

NOTICES TO CORRESPONDENTS.

R. G. (Toulon).—With reference to the *Royal George*, the following is the only information we can at present give you upon the subject. This calculation was made by the late Mr. Peake (master shipwright, R.N.) for the late Captain George Harris, R.N., when commanding the *Hussar* frigate, and it was handed to us by the latter gentleman, together with a number of notes on naval construction.

"Calculations on the *Royal George* at the instant she sank, before the hull had imbibed any water:—

	Tons.	cwt.	lbs.
Iron ballast	180	0	0
Guns	217	2	0
Shot	72	5	2
Anchors	19	16	3
In air	489	3	5
Iron to water at Spithead } 7·45)490·00(66 / 4470 / 4300	66	0	0
In water, say	414	0	0
Shingle ballast, 223 tons by the lightermen's weight, but it is a quarter too much by the immersion of the ship	167	0	0
Coals	30	0	0
In air	197	0	0
Ballast to water, 1·5; allow it to be 2· when filled the interstices — In water, say	98	0	0

	Tons.	cwt.
Then—Iron	414	0
Shingle and coals	98	0
	512	0
The provisions, such as beef, pork, flour, and raisins, being somewhat heavier than water, call it	4 tons	
Cables, and cordage in the store-rooms	10 „	
	14 tons.	

As to all the other provisions, and store in rooms, they would float, perhaps, more than the above 14 tons; therefore, after the yards and topmasts, &c., were taken away, the aforesaid weight of 512 tons was the utmost the ship could weigh; but, as the hull of itself would sustain at least 150 tons—192 tons by the density of the different parts of the hull—it would reduce the weight to 362 tons, and this, again, would be reduced by the powder barrels and casks in hold (empty), sustaining many tons, so that, probably, at a week's end, the ship might weigh—say, in round numbers, 400 tons. In fact, I really believe the ship could not have been more than 320 tons at the instant she sank; and I must be vastly out indeed if those that have made her three and even four times as much are right in *their* calculations. She displaced about 3,600 tons when afloat."

R. C. D.; P. Roberts; and Beyfuse.—Declined, with thanks.

J. (Leeds).—We shall be glad to receive the papers.

Young Engineer (Leeds).—1st, No; 2nd, The arrangement of engine described has advantages over the two-cylinder combination, although from the trunk being at the high-pressure end, the loss of heat by its exposure at each stroke is a set-off against the advantages it possesses. There is, however, nothing new in the idea; it has been patented by about eight different persons, and by mere chance a paper was read at the Institution of Mechanical Engineers, Birmingham, about three months ago. If you send your exact address, we will inform you respecting your first inquiry.

R. R. (Glasgow); J. C.; T.; J. B.; and others.—By post.

D. (Calcutta); E. Richardson, jun.; J. Barlow; and other correspondents whose addresses are not appended to their letters, will please to furnish them, whereupon their requests shall be attended to.

Various Reviews and Notices of New Books are unavoidably omitted this month for want of space.

The continuation of "Who Invented the Screw Propeller?" and other papers, &c., must stand over until next month.

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c

UNDER this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.—ED.

PUDDLED STEEL.—PATENT LAW.—QUESTION OF AFFIXING THE GREAT SEAL. In the Court of Chancery (12th January ult.), Mr. James Spence, of Liverpool, petitioned that the Great Seal might be attached to a patent for making tinned plates from puddled steel, notwithstanding that an opposition had been entered by Messrs. Clay (Mersey Steel and Iron Works, Liverpool), and by Mr. Benzon (Naylor, Vickers, and Company, Sheffield), on the ground that Mr. Spence cannot claim a patent for using *puddled* steel for tinned plates, as tinned plates have been previously made from steel manufactured in the ordinary way; that, therefore, there is no novelty in steel tinned plates; and that, if there were, Mr. Clay suggested the idea to Mr. Spence. The Lord Chancellor said this was a case in which the question in dispute between the parties ought to be tried at Law. By refusing to seal the patent, this Court would prevent such right from being exercised; and, therefore, he thought that the proper course would be to order the patent to be sealed.—Ordered accordingly.

DANGER BY SPARKS FROM A RAILWAY ENGINE.—In the North, the Right Honourable Jane Douglas, Lady Montague, "raised an action," recently, against the North British Railway Company, in the Sheriff's Small Debt Court, at Dunse, for £5, as damages caused to a small plantation (called Brackholes) on her estate of Buncley, near the line of railway, by a spark from the tender of one of the engines having (on the 30th March last) set fire to the plantation. A preliminary objection was raised, on the part of the Company, to the effect that, as there was no averment of "culpa" (fault), there was no ground for damages, the Company being engaged in a lawful act at the time. This line of argument appears to have prevailed with the Sheriff, who "allowed the case to be withdrawn, on payment of a small sum of expenses by the Company."

THE TYLDESLEY COLLIERY EXPLOSION.—At the adjourned inquest recently held on the twenty-five persons killed by the explosion on the 11th December ult., the jury returned a verdict of "accidental death," expressing, as their unanimous opinion, that due precautions had not been taken to insure the lives of the workmen employed in the mine; finding that the ventilation of the mine had been generally imperfect, more especially from the area of the outlet always being much too small. Also, great want of practical knowledge of the working of the mine on the part of the underlooker; and also that the firemen had neglected their duties.

THE FACTORY ACT.—At the Accrington Court House, Messrs. Watson Brothers, of Church, were recently fined £2, with costs, in each of twenty cases, for allowing young persons to work after 6 o'clock in the evening. The number of cases was much smaller than might have been taken, as the mill was found to be in full operation at a quarter past 6.

THE FATAL ACCIDENT (SUFFOCATION) AT THE TORPOINT SULPHURIC ACID WORKS.—At the inquest held (17th January ult.) at Torpoint, near Plymouth, the medical evidence showed that the cause of death was "the inhaling of nitrous acid gas." That the fumes of nitrous acid, taken into the body, produce great stimulation of action in the mucous surfaces, the bronchia, and stomach, ultimately bringing on asphixia and death. The commercial strength of the acid was 175 degrees; the liquid, on this occasion, was about 110 degrees. Ozone, it was believed, was present in the chamber. The jury returned a verdict that the deceased (two men) came to their death accidentally from inhaling the fumes arising from a quantity of sulphuric acid, and there appeared to be no want of care on the part of the manager of the works.

RAILWAY LIABILITIES—DIVERSION OF A STREAM.—In a recent case—Morton *v.* the South Western Railway Company—cause was shown (Queen's Bench, 12th January ult.) against a rule for a nonsuit. The action was on a judgment signed on a verdict given by a jury on an inquisition before the Sheriff to assess the amount of compensation to what plaintiff was entitled for injuries done to his property by the works of the defendants in constructing their line of railway. Plaintiff was the owner of a tanyard, into which two streams flowed. Defendants carried the principal stream, by a syphon, under their railway into plaintiff's premises, and diverted the smaller stream from plaintiff's land, and carried it in a channel along the side of their railway. The sheriff's jury having awarded plaintiff £400 as compensation, their finding was entered on record as a judgment, upon which the present action had been brought, and in which plaintiff had succeeded. A rule was then granted for a nonsuit, on the ground that as plaintiff's property was not injuriously affected, the sheriff's jury had exceeded their jurisdiction in giving compensation for matters beyond their powers. Lord Campbell discharged the rule, being of opinion that there was jurisdiction. The plaintiff was entitled to the water of the stream, which he had used for upwards of forty years. Supposing that the jury had exceeded their jurisdiction, that would have been ground for a *certiorari* to remove inquisition and set it aside; but that question had already been determined by this Court on an application for a *certiorari.* The other judges concurring in this opinion, the rule for a nonsuit was discharged.

STEAM THRESHING-MACHINES had been declared (by a Bench of West-Riding Magistrates, at Otley, in Yorkshire) not to be exempt from toll after they have passed 2 miles upon the turnpike-road; but they, at the same time, granted a case for the opinion of the Court of Queen's Bench upon the point. It being subsequently found, from a defect in the proceedings, necessary to raise the question before the magistrates, it was contended, for the complainants (Messrs. Humphery and Co., of Leeds, steam threshing-machine manufacturers, against the collectors of tolls on the Otley and Skipton turnpike-road), that, according to the proper construction of the Turnpike Act, threshing-machines, and all other implements of husbandry, were exempt from toll, whatever distance they travelled on the road, and that the limitation of the Act to 2 miles applied to an entirely distinct matter. (The machine in question was passing along the turnpike-road on its way to a farm to thresh corn; the toll (3s.) had been taken, on the ground that the machine had travelled 2 miles on the road). The magistrates came to the conclusion that the former decision must be reversed, and that the threshing-machine was exempt from toll, whatever distance it went upon the road.—Collectors fined in nominal penalty of 1s. each and costs.

DAMAGE TO BOILERS OF THE "URGENT" STEAM TROOPSHIP.—LIABILITY OF ENGINEERS.—At a court-martial held (7th January ult.) on board Her Majesty's flagship *Victory*, at Portsmouth, the assistant engineer (2nd class) belonging to Her Majesty's troopship *Urgent*, was tried for damage done to certain boilers during the time of his being in charge of her (on or about the 21st December, 1858), and to inquire into his conduct on that occasion. The Court (president, Rear-Admiral the Hon. G. Grey, superintendent of Her Majesty's dockyards), having heard the evidence of the several witnesses, found that the charges were proved, and reprimanded the said assistant engineer, admonishing him to be more careful for the future.

COLLIERY DRUMS—LIABILITY OF JOINERS.—At the inquest (6th January ult.) on the seven persons (three men and four boys) killed by the accident at the Agecroft colliery, Pendlehury, near Manchester (owners, Messrs. Knowles and Sons), it appeared that the "cage" coming above the usual place, dashed against the pulley, and the rods of the cage snapping, it dropped down the pit. A bell signal ought to have indicated when the cage was 60 yards from the mouth of the shaft, but on this occasion it had not sounded, although it had done so in three or four cases of men coming up immediately preceding. The strap which worked the bell-weight had broken, the end was drawn out of the slit where it had been fastened into the axle by a wooden wedge. One wedge was placed in three years and a half since, and never taken out till just previously to the accident. The cage was one of Owen's safety cages. The joiner, in his evidence, said, he had altered the drums on the preceding Monday, to make the cage come up faster; the next morning the engineer bade him alter the strap which worked the bell-weight. He fastened it as it had been before, driving a new wedge in with it, and stayed to see it work. It was a new and seasoned wedge, and fitted tight. The coroner, in summing up, said if any person was blameable it appeared to be the joiner, as the wedge seemed not to have been put in securely, which was the cause of all the mischief. The jury having returned a verdict of "Accidental death," the coroner censured the joiner for not being more careful, and Mr. Dickenson (the inspector of mines for the district) said, so many accidents had occurred at Messrs. Knowles' collieries, that they ought to get some very competent superintendent.

THE GREAT EASTERN STEAM-SHIP.—The action for rent for the yard in which this great vessel was built (the commencement of which, before Mr. Justice Willes and a jury, in the second Court of Common Pleas, we noticed in our last number's "Notes and Novelties") has been since settled while in course of hearing. The judge suggested a private settlement, and it was left to his lordship, who then said, there ought, in his opinion, to be a verdict for £2,500 for the four months from October 16th till the 1st of March. Verdict for the Plaintiffs, £2,500.

UNPROTECTED MACHINERY.—In the case of the trial of an action (Schofield *v.* Schunk) against millowners for not securely fencing a part of the machinery of their mill, whereby injury was occasioned to one of the persons employed therein, the judge left the question to the jury "whether the machinery was fenced in the ordinary manner used and approved as sufficient at the best regulated mills in the district." It was held that this was not enough, for that the proper question was whether the mill was securely fenced according to the *best* method of fencing known at the time.

THE HAVANT STATION RAILWAY DISPUTES.—The Vice-Chancellor, Sir W. P. Wood, refused (19th January ult.) an injunction moved for by the London, Brighton, and South Coast Railway Company against the London and South Western and the Portsmouth Railway Companies, to restrain the latter two companies from using the joint station at Landport, Portsea, for the booking or transport of passengers or goods destined for or coming from the Portsmouth railway, excepting for traffic on the public service, naval or military, with the Crown establishments at Portsea or Portsmouth. The question turned entirely upon the construction of the Act of 1847, Sec. 13, by which the South Western and the Brighton and South Coast Companies were authorised to purchase, and a third company was authorised to sell, a portion of line for the purpose of being jointly used by the two companies as a joint line, and which Act, as the Vice-Chancellor held, was in no way modified by the Portsmouth Railway Amendment Act of 1858. There must, therefore, as between the contending companies, be a user of the joint station. Injunction refused. Costs to be costs in the cause.

PARISH RATING OF TELEGRAPH WIRES.—A novel question of law is likely to arise. The Board of Governors and Directors of the united parishes of St. Andrew, Holborn, and St. George the Martyr, having recently resolved to assess the wires of the Electric Telegraph Company, laid along Holborn—from Holborn Bars to Feuwick Court—at the sum of £100, the wires not having hitherto been assessed.

THE "TELEGRAPH SLANDER CASE" again.—Lord Campbell (Court of Queen's Bench, 21st January ult.,) has granted a new trial in this case—an action for slander—Whitfield and others, bankers, *v.* the South Eastern Railway Company, in sending by telegraph, and publishing at different stations on the South Eastern Railway, a message to the effect that the Lewes Bank had stopped payment, and in which the plaintiffs obtained a verdict—damages £2,000. Lord Campbell thought there ought to be a new trial, both parties being at liberty to amend; he at the same time advised the parties, on such new trial, to submit their disputes in the form of a special case. The application for a new trial was on the ground that the verdict was against the evidence.

FENCING RESERVOIRS.—In a recent case, argued 21st January ult., (Hardcastle, administratrix, *v.* The South Yorkshire and River Dunn Railway Company), the Court of Exchequer decided that the company in question, successors to the proprietorship of the navigation of the "River Dunn," were not legally answerable for an accident (by drowning) arising from neglect in not fencing a reservoir and bye-wash forming part of such navigation. The plaintiff was the widow and administratrix of a person who was drowned on the 22nd May, 1858, in a reservoir belonging to the defendants. His widow had brought an action under Lord Campbell's Act. Defendants' predecessors had twenty-four years ago made a new cut, consisting of a large reservoir, out of which there were two branches, one for the passage of boats, and the other as a bye-wash for surplus water. The deceased, having crossed the bridge leading over the wash, turned to the right (the ancient footpath from Rotherham to Sheffield leading along this bye-wash), and fell over the buttress of the bridge into the water. At the trial it had been contended that a private injury arising out of a public way, rendered the party liable to an action. The Lord Chief Baron in his judgment said that if a person trespassed upon land adjoining a public footpath, and so came to mischief, he, and not the owner of the land, was liable. If fences were to be put up, it would be more reasonable that they should be put up by persons using the path, and those who were under obligations to repair it, than by those who dedicated it to the public. There was no such obligation to fence the path as alleged; and, on the state of facts, as disclosed at the trial, no liability was incurred.—Judgment accordingly for the defendants.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

WE have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "18, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

A NEW SMOKE-CONSUMING GRATE (patented) has been recently introduced. The coals are introduced at the bottom of the fire, under the ignited embers, so that the whole of the gases given off are burned. (?) The apparatus by which the coals are introduced into the fire consists of an iron tray, fixed to the lower portion of the front of the stove. Along this, right and left handed Archimedean screws, (joined together about the middle of the grate) are placed. When the fire is to be fed, fresh coals are placed in the tray, on the top of the screw, which is then turned by a ratchet-work, moved by the poker. By the revolution of the screw, the burning embers are raised up, and the fresh coals deposited in the cavity underneath. The mechanical arrangement is stated to be equally applicable to furnaces; for if the screw be moved at a slow rate by a lathe-band from steam-machinery, it would deliver the coals into the fire at a regular and uniform speed, without slacking the draught by opening the furnace door.

A SMOKE-PREVENTING "FLUE PEDESTAL," having for its main object the prevention of smoke, by washing the latter by means of jets of water, has been provisionally registered by Mr. C. J. Richardson. It is stated to be applicable to every flue in a house, and the soot from the whole of them is to be carried down to the drain. The "flue pedestal" has still another (alleged) recommendation: placed in one of the upper rooms of a house it becomes a hot-water pedestal, supplying warm water to the room, and moderately warming it by means of the fires in the lower parts or floors of the building.

THREE LIFEBOATS FOR THE PORTUGUESE GOVERNMENT, ordered by Admiral Sir George Sartorius, are now constructing by Messrs. Forrestt, of Limehouse.

THE TOTAL POPULATION OF THE AUSTRALIAN GROUP (omitting Western Australia, estimated at about 14,000, but of the statistics of which colony there are no reliable records) was at the close of 1857, 1,037,500 souls; viz., Victoria, 489,000; New South Wales, 306,000; South Australia, 110,000; Tasmania, 82,500; New Zealand (approximate), 50,000.

A SUBSTITUTE FOR RED-LEAD has been patented for Messrs. Bouchard and Clavel, of Paris. The inventors, for this purpose, claim the application of ochreous earths in general; and, more particularly, of a species of red-ochre, very rich in silica and alumina, found in the departments of Yonne, France, and called Burgundy red, the composition of which is—Silica, 50·00 parts; oxide of iron, 14·50 parts; alumina, 26·60 parts; carbonate of lime, 7·60 parts; sulphate and phosphate of lime, magnesia, loss 1·30 parts = 100·00. Cement prepared from this earth is alleged to be an advantageous substitute for red-lead in making joints of boilers, water and gas pipes, &c., by mixing with grease, oil, lime, and with fragments of unburnt earthenware, Roman cement, and chalk in about the following proportions:—Burgundy red, 66 parts; grease or oil, 15 parts; lime, 11 parts; unburnt earthenware, chalk, or Roman cement, 8 = 100. Diluted with volatile oil, this Burgundy red, or other analogous earth, serves as a coating for preserving metal to prevent oxidation.

PREMIUMS FOR INVENTIONS AND DISCOVERIES.—Amongst the premiums (money or gold medals) offered this year by the Society of Arts are—the gold medal, for the discovery of a *substitute for cotton*; ditto for the production of an *incombustible paper*, so as to render the ledgers of commercial men, bankers, &c., indestructible by fire—and an efficient means of carrying out the system of *Oceanic electric telegraphs* between distant countries, including, in plan, perfect insulation, minimum of resistance to the current sent, rapidity of communication, use of minimum power, freedom from accident by air or water, and power of resisting mechanical strains. For an *economic system of railway transit*, applicable to common roads, so as to connect thinly-populated districts with each other, and with the main lines of railway. The introduction *of a system of railways upon common roads*, and in the streets of towns, cheap and effective for goods and passengers.

THE (FRENCH) ARTIFICIAL PEARLS are made by the following process:—The scales of the fish called bleak, for which the streams of the department of the Meurthe are particularly noted, are, by an ingenious process, reduced to a kind of lustrous paste called "Essence d'Orient;" and the French artificial pearls are simply small hollow glass balls, coated inside with this paste, and filled with white wax.

AMERICAN POST OFFICES, ROUTES, &c.—The Postmaster General's recent report states, that the whole number of post-offices in June last was 27,977; length of routes, 260,603 miles; cost, 7,795,418 dollars. Total expenditure for the year (for this department), nearly 13,000,000 dollars.

SHIPWRECKS AND THE SHORE.—An (alleged) improvement on Manby's apparatus has just been introduced in France, under the patronage of Admiral Hamelin, the French Minister of Marine. The new apparatus for establishing communication between shipwrecked vessels and the shore, and *vice versâ*, is the invention of M. Bertinelli, of Turin, and consists of a wooden shot, to which a line is attached, and which, impelled by a feeble charge from a gun on board a ship, or on shore, will reach to the distance of 800 yards; whilst that of Manby and others, it is stated, have never attained a practical range of more than 200 yards. Admiral Hamelin, in his published notice of this invention says, that the French Government have aided M. Bertinelli in his experiments, to the success of which he can testify.

THE BOARD OF TRADE RETURNS for the month of November, 1858, just issued, show the following results:—Total declared value of exports for the month, £9,976,436; against corresponding month of 1857, £8,285,815.

SHIPPING TRADE.—In November last, there were 2,966 vessels employed in the foreign trade; tonnage, 669,634, entered inwards; against, in corresponding month of 1857, vessels, 3,020, with a tonnage of 754,023. Cleared outwards, during the same periods respectively, 3,046 ships; tonnage, 716,790; against (in November, 1857), 3,261 ships—788,467 tonnage.

SHIPWRECKS IN THE ROYAL NAVY.—Between the years 1793 and 1857 no less than 424 ships of the Royal Navy were lost by casualties at sea.

COASTING TRADE, for same period, 11,610 vessels, 1,265,213 tonnage, entered inwards; and 12,382 ships, 1,312,129 tonnage, cleared outwards; against (in November, 1857)—ships, 12,206; tonnage, 1,293,267; and ships, 12,403; tonnage, 1,310,531.

THE TUNNEL UNDER MOUNT CENIS is still progressing. It is found that, on the Savoy side, at Modene, the filtration of water opposes considerable difficulty in prosecuting the works, yet not so as to completely interrupt the boring process.

THE GLASS TRADE, more especially in the North of England, is at present in a very unsettled state. A general "lock-out" of the operative glass-makers is daily expected. To resist the alleged unreasonable demands of the Workmen's Union, the employers have formed a counter-association; and the first blow at the operatives' combination has been a resolution of the employers to close all works against society-members. The numerous glass-works in the district around Dudley and Stourbridge are already shut; and it is apprehended that the "lock-out" may soon extend from Birmingham to Newcastle-on-Tyne.

A LARGE IRON ENGINE-HOUSE FOR CHILI has been manufactured by Messrs. Bellhouse and Co., of Manchester, for shipment to Santiago. It will cover a space of 24,000 sq. ft., forming a regular polygon of forty-eight sides; diameter, 171 ft.; height at the eaves (which project 2 ft.), 17 ft. 9 in., including an ornamental iron grating, running round the entire building. The roof consists of sixteen bays, supported by as many ornamental columns, disposed in a circle 61 ft. in diameter. Length of the principals supported by these pillars, 80½ ft., rising from the eaves, and continuing to the spring of the cupola. Roof surmounted in the centre (where it is 40 ft. high) by a ventilating cupola, 17 ft. in breadth, and rising to a total height of 62 ft. Eleven large entrances or archways for engines, and five smaller ones. External limits of the building supported by forty-eight moulded pilasters.

THE BRITISH NAVY [IN 1859].—An official return of the ships now composing the British Navy, shows that, exclusive of gun-boats, we now possess 523 vessels, of which 176 are actually in commission. The channel squadron appears to consist of but one screw decker and four screw two-deckers, but will probably be strengthened in the ensuing spring and autumn.

A NEW SMOKE-CONSUMING APPARATUS has been invented by Mr. David Partridge, assistant chief-engineer of the Steam Factory Department at Woolwich. It is ordered to be applied to steam-vessels in the Royal Navy.

WOOD-CARVING BY MACHINERY.—In a recent number of our Journal we adverted to the, then, apparently unpromising prospects of this invention—at least, as a commercial speculation. It now appears that these really beautiful machines, formerly worked under the Jordan patent, in the Belvidere-road, Lambeth, and to which the Houses of Parliament and other important buildings are indebted for their carved woodwork, have not shared the fate of the Company that fruitlessly attempted their commercial development, but are now in active, and, as it is asserted, profitable operation in other hands, on premises exactly opposite their former *locale*. The operations of the machine in question will, for the future, be confined to the rough definitions of the form and pattern desired, hand-labour being called in aid to finish and perfect the design and details.

RAILWAYS, &c.

CAPE TOWN.—The Railway and Dock Company having completed an amended contract with the Local Colonial Government satisfactory to all parties, Mr. Brounger and a portion of the engineering staff have sailed for the colony. By the terms of the new contract, the Government may, after twenty years, purchase the land, subject, however, to a clause insuring, under any circumstances, the repayment to the shareholders of the actual cost of the line. Works to cost £400,000, exclusive of rolling stock; to be completed within two and a half years from 5th October last, or six months within the time required by the contract with the colonial authorities.

NEAPOLITAN RAILWAYS.—SALERNO AND TARANTO LINE.—In the exercise of what is generally considered, even by the Italian lawyers themselves, as an illegal and tyrannical stretch of power, the Neapolitan Government have confiscated the caution-money, which M. D'Agiout had deposited, as concessionaire (in 1856), of this line of railway. M. D'Agiout, it is understood, is taking steps to contest the question, as one of general right and international law.

RAILWAY SQUABBLES.—The London and Brighton and South Western Railway Companies have been recently engaged in actual hostilities. The former endeavoured, by the removal of rails, the tongues of junction-points, &c., to prevent the South Western trains running over the line from the Havant Junction to Portsmouth. An amicable adjustment of their mutual differences has since been made by the two companies.—See Legal Decisions, "Havant Station."

THE NORTHERN [OF SPAIN] RAILWAY COMPANY has just made the adjudication of a contract for the supply of 300,000 sleepers, of pine, from the Landes, prepared by the process of M. Boucherie, to be delivered in the course of the year 1859.

A NEW RAILWAY TERMINUS is to be built at Enniskillen for the Dundalk and Enniskillen Company. Total length, 184 ft. Platform 21·9 wide at centre of building, and 15·0 throughout.

THE RAIL IN STREETS.—At Genoa a railway traverses the whole length of the city, through one of its busiest streets. The portion of the street devoted to the railway is divided off by an iron railing. At the crossings a chain is hooked on as the train approaches, and allowed to fall again when it has passed.

COLLISION ON THE SOUTH WESTERN LINE.—*Basingstoke Station.*—A serious accident occurred (22nd December ult.) at this station, in consequence of the Southampton 11·30 train running into the Salisbury train, due at the same place a few minutes previously. The latter had arrived at its proper time, and was shunting into a siding, when the Southampton train approached, and although the danger signals were all properly exhibited, the driver was unable to bring up his engine in sufficient time to avoid a collision. The two last carriages of the Salisbury train were knocked off the rails, one of them falling completely over on to the down line, and seriously hurting several of its occupants.

FATAL ACCIDENT ON THE STOCKTON AND DARLINGTON RAILWAY.—On the 22nd December ult., between the Eston junction and Cargo Fleet station, a party of pedestrians, instead of walking on the footpath, which runs parallel to the railway on the top of a bank, descended into the cutting to obtain shelter from the wind, which was blowing very strongly in their faces, when suddenly, where the line makes a curve, a train, consisting of engine, tender, and some empty carriages, dashed up from behind them, at the rate of 14 miles an hour, scattering them in all directions. One of the party was killed, and another frightfully injured. The coroner's jury returned a verdict of "Accidental death."

GRUPON AND ARLON [LUXEMBOURG RAILWAY]. A land-slip of 30,000 cubic metres has completely buried the line at this point. It will take a month's labour to clear the road.

RAILWAY CURVES.—RESISTANCE.—With reference to the influence of curves upon resistance, it has been found that, at a speed of 45 miles per hour, the traction-resistance was greater by 20 per cent. on a line having curves under 1 mile radius at the curve in 2½ miles, than on a practically straight line.

GRADIENTS.—The steepest gradients in this country, over which a large traffic is conveyed, are considered to be on the line between Manchester and Oldham, a distance of 7 miles. For 1¼ miles there is an inclination of 1 in 48 or 1 in 50, the line is then tolerably level until, on approaching Oldham, gradients of 1 in 31 and 1 in 39 are encountered, and for about 1¼ miles 1 in 27.

FATAL ACCIDENT IN A RAILWAY TUNNEL.—On the Edinburgh and Glasgow railway, about midnight, 18th December ult., a man had, unobserved, as it appears, by the watchman on duty at the Queen-street station, entered the tunnel between Cowlars and Queen-street, when he was knocked down by a goods' train, and so injured that he died in about 24 hours afterwards, in the infirmary. The breaksman, it appears, had seen the man in advance of the train, and every effort was made to arrest its progress, but before it was finally stopped one of the trucks had overtaken and knocked down the deceased; and a lever, brought from the station, had to be employed in raising the truck before he could be removed from under it.

THE SEVILLE AND CADIZ RAILWAY is stated to be progressing favourably. The works are approaching completion, and the line will probably be opened for traffic between April and June next. On the 20th December ult., the shares were admitted to the privilege of quotation on the Paris Bourse.

JAMAICA.—FROM SPANISH TOWN TO OLD HARBOUR.—In the Jamaica House of Legislative Assembly (27th December ult.), a bill to extend the railway from the former point to the latter had been read a second time. Other bills to promote railway extension had been read a second time, and awaited committal to the whole House.

The Victoria Station and North-Western and Great Western Junction.—The examiners on standing orders declared (19th January ult.), this projected line to be one in which the standing orders had not been complied with. Consequently, the announced application to Parliament for this undertaking is lost—at least, for the forthcoming session.

The Great Indian Peninsular Railway is slowly extending itself; a line of 64 miles having been opened on the Sholapore Branch (Poonah to Diksal) on the 15th January ult.

Cuttings.—Two Accidents [One Fatal] by Earth-slips have occurred on the East Kent Railway Works. At Faversham, about 3 miles from the station, a cutting, 25 ft. deep, is now in progress; the earthwork gave way and fell with a tremendous crash, burying two men, and dashing them against the waggons at the bottom of the cutting: one died. At Chilham cutting a man was engaged pushing the waggons along for coupling, when the earth suddenly gave way, burying him up to his shoulders. He was extricated after much exertion, but died about six hours afterwards, in the Kent and Canterbury Hospital, of the injuries and exhaustion.—Verdict, "Accidental death."

Level Crossings.—A Fatal Railway Accident occurred (evening of 20th January ult.) at the New Street Station, Birmingham, to an elderly female, who, in the act of passing over the level crossing opposite one of the gate-entranees to the station in Great Queen Street, was knocked down and killed by what is termed an "empty" engine then slowly coming up.

London and Brighton Railway.—Gross receipts for the past half-year, £447,423; showing an increase of £16,062 over corresponding half-year of 1857; and making revenue of 1858 amount to £791,993, or £11,406 in excess of the previous year. Expenditure, £199,909, or 44½ per cent. of the receipts, being at the rate of 3s. 2¾d. per train per mile. Number of passengers conveyed in 1858, £7,424,688. Receipts for ditto, £546,601. Total working expenses for same year, £231,844. Extension of Company's Epsom Line to Leatherhead will shortly be ready for opening: a further extension of the line to Dorking is decided on. Company's Victoria and Pimlico Bridge over the Thames will probably be completed before the time fixed by contractor—viz., June 1, 1860.

Halifax to Quebec (New Brunswick).—The largest and most influential public meeting ever assembled was held at St. John (on the 7th December), to adopt measures for constructing "an Inter-Colonial Railway" between these points.

Vienna to Linz.—On the 15th December ult., the first train left Vienna for the latter place. Omnibuses, built on the true London model, conveyed the passengers to the terminus, and great, says the "Times" correspondent, was the admiration of the Viennese (especially the hackney-coachmen) at the new-fashioned vehicles and harness; but the local Jehu's declared their conviction that not one Viennese in a hundred will ever peril his shins and neck by being an outside passenger.

Egyptian (through) Line, from Alexandria to Suez.—The passengers by the *Niagara* (Royal Mail Company's chartered steamer, arrived 20th December ult.) were the first persons who travelled all the way by rail between Suez and Alexandria, the Egyptian railroad having been finished just before they arrived at Suez. On some parts of the railway they travelled at the rate of forty miles an hour: thus, the short route to India, China, Japan, and Australia, can now be traversed by railway and steam-packets throughout.

The Pacific Railroad is pointed out by the American President, in his late message, as worthy the attention of Congress. He would not, for political (anti-jobbing) reasons, have the work undertaken by the State; but Congress, he adds, might assist incorporated companies by grants of land or money, or both, under reasonable terms, as to conveyance of United States troops and mails.

The Isthmus Routes (Central America), Nicaraguan Accessory Transit Company.—The President recommends to Congress the passage of an Act authorising the employment of the land and naval forces of the United States, to prevent this transit from being obstructed or interrupted by the Nicaraguan Government; the transit to be thrown open to general competition, on payment of a reasonable rate to the Nicaraguan Government on passengers and freights.

The Panama and Tehuantepec.—An Act of Congress for the protection of these transit routes is likewise recommended by the American President.

The Victoria (Australian) Railways.—The Goverment of Victoria, through the agency of a Committee appointed by the six Associated Australian Banks, are negotiating in this country for a loan of not exceeding one million sterling, portion of the £8,000,000 sterling authorised to be raised by the Railway Loan Act of the Legislature of Victoria of the 24th November, 1857, for the construction of railways in the Colony. The operation is by public tender, in 6 per cent. debentures secured on the Colonial revenues.

A Fatal Accident occurred (5th January ult., 7 a.m.) on the Lancashire and Yorkshire Railway, near Failsworth, in the Maston cutting. One of the plate-layers, about to commence work, went on the up-line to look for his spade. Warned of the approach of a train from Manchester to Oldham, he failed (the morning being dark and foggy) to get out of the way before it was upon him. He was literally cut to pieces.

The Charleville and Sedan Railway (Section of the "Ardennes"), has been inspected by the Committee of Engineers appointed by the Minister of Public Works. Its principal structures are two bridges over the Meuse. The line was announced to be opened for traffic on the 14th January, 1859, as far as Douchery, a small town on the Meuse, about two miles from Sedan.

The Railway from Lucca to Pisa having been sold by auction, owing to the bankruptcy of the Company, has been purchased by the Grand Duke of Tuscany.

The Receipts of the French Railway Companies during the present year (1859) will probably exceed 350 millions of francs. The companies have to pay at this moment about 115 millions of francs for interest on their bonds; working and other expenses estimated at 50 per cent. on their receipts (or 150 millions)—thus there will remain 85 millions to be divided among the shareholders.

Head of Lake Superior to Red River.—A railway to effect this junction is on foot. The object of Sir Alan McNab's visit to this country is to promote this undertaking.

An Attempt to Upset a Railway-Train was recently made by a lad who was (4th January ult.) charged at the Shire-hall, Gloucester, with placing a piece of iron, called a "chair," on the Great Western Railway, with intent, &c. The railway from Gloucester to Cheltenham is a "mixed gauge," and the "chair" is an iron frame, by which the metals on the narrow gauge lines are secured to the sleepers. One of these chairs was (on the 31st December ult.) found to have been placed on the top of the broad-gauge rail, and *secured by means of screws*, near the Sugar-loaf Bridge, at the Churchdown cutting. The mischief intended was, however, happily averted; for, on the arrival of the 11 a.m. train from Gloucester at this spot, its impetus, aided by the "lift" affixed in front of the engine, was sufficient to remove the obstruction; and, except a shock, nothing injurious happened to the train. The accused, who, it appears, is of weak intellect, had been seen near the spot, and a footprint was traced along the embankment to one of the telegraph posts, where the "chair" had been thrown aside on a heap of old materials; thence to the spot where the chair was attached to the rail, and thence, along the line, to another bridge, where the track was lost. The footprint, it was stated, corresponded with the shoe worn by the accused, who was remanded for the police to procure, if possible, further evidence. Ultimately, the magistrate discharged the prisoner, remarking that there was no doubt as to his guilt, but he thought no jury would convict upon the evidence adduced.

A Combined Railroad Track and Cast-iron Pavement has been patented in America, by Walter Bryent, of Boston, Massachusetts. He claims the combination of a cast-iron pavement and railway, cast and united together in suitable sections: also the combination of the tenons and mortises on the ends of the rails; and the alternate over and under lapping tongues on the edges of the pavement, for the purpose of interlocking the adjacent sections of the combined pavement and railway.

A Railway Accident [by Collision] occurred (13th January ult.) at the Craven Arms station of the Shrewsbury and Hereford line, resulting in the serious injury of several passengers. A luggage train from Shrewsbury passing on down the main line (which is a single one), without turning off into the siding provided at each station, for the reception of one train while another passea it, ran into a passenger-train coming in the opposite direction. An investigation is promised.

Egyptian Lines now Completed.—Egypt possesses the following lines:—From Alexandria to Cairo, 131 miles; to Mariouth, 17; to Meks, 6; to Rassateen, 3; from Tanta to Samanud, 21; from Cairo to Suez, 91; to Barragd, 15; to Beni Sueff, 76—in all 360 miles. Besides these, there are smaller branches,—from Cairo to the Citadel and Kasr Nin; from Samanud to Mansoura and Damietta; from Damanhour to Afte, which last extends to Rosetta. Exact mileage of these not yet accurately known. When the Egyptian railway system is properly developed, there will, it is calculated, be a saving of £20,000 per annum in the expense of forwarding the Indian mail.

A Fatal Accident occurred (7th January ult.) on the Great Northern railway, about 5 miles from Doncaster. A plate-layer was repairing the line, near the Rossington station, and seeing an up-train approaching, he stepped on one side (between the down metals) to allow of its passing: but not noticing the simultaneous approach of a down-train, and, consequently, making no effort to get out of the way, he was run over, and literally cut to pieces; some portions of the body being found attached to the engine when it reached Doncaster.

The State of New York Railroad Companies (now, 1859) possess a capital of 74,289,488 dols. 98c., divided among thirty-eight companies. Of this amount 68,198,758 dols. 15c have been paid in. Their funded debts amount to 69,198,758 dols. 25c.; their floating-debts are 4,548,806 dols. 69c., making an outlay in their construction of 136,681,690 dols. 34c. Fourteen companies alone declare dividends.

A "Railway Catastrophe [America] has recently occurred on the Columbus and Macon railway, State of New York; number of victims about 19: the cars fell 30 ft., and into a stream."

Western India is being rapidly intersected by railways. About 150 miles are now constructed, and a large portion of the whole 1,128 miles laid down is now in progress. In the Bombay Presidency Railway Works there were in 1857-8 no less than 70,000 men employed.

A Fatal Accident occurred (15th January ult.) on the South Western Railway, at the Farnborough station. One of the Company's servants, whilst assisting to shunt some carriages in the goods' train, fell under the waggons, and several vehicles passed over his neck, severing the head from the body.

Railroad Accidents in America.—In 1858 there were in the United States eighty-two railway accidents, resulting in the death of 119 persons, and grievous injury of 417. Diminution in number of accidents, as compared with 1857, about 40 per cent: still larger decrease in the number of persons killed and injured.

Mezidon to Argentan, on the Western [of France] Railway.—This section will be opened to the public on the 1st of February, 1859. This will complete the section from Mons to Mezidon, and thus connect the two great lines of Normandy and Brittany.

Rennes and Brest.—The Council of State has adopted the line along the coast for the railway to be constructed between these points.

TELEGRAPH ENGINEERING, &c.

Indian and Australian Submarine Telegraph.—The first length of cable for this line—viz., that for the section between Suez and Aden—has been manufactured by Messrs. Newall and Co., at the Birkenhead Works, and is now ready for shipment. The screw steam-ships *Imperador*, *Imperatrix*, and *Bahiana*, have been purchased by them for this peculiar service. The two former will receive about 1,000 miles each. In the fore-hold of each ship is a cylinder made of iron plates 31 ft. in diameter, and 14 ft. in depth, which will receive one coil. In the after-hold is a cylinder 31 ft. broad by 10 ft. deep, which receives a second coil; and between the main and lower decks is a cylinder 28 ft. in diameter by 4 ft. 6 in. deep. The deck has been cut through, to enable the cylinders to be placed in position.

A New "Great Ocean Telegraph Company" has been established for connecting Great Britain with America, by means of Allen's system of submarine wires. Direct communication between London and New York—by a line from the Land's End to Halifax—to be carried ultimately by Bermuda to Jamaica, and thence, by connecting lines, to the other West Indian Islands, the central States of America, and the Brazils. Weight per mile of the line, from Land's End to Halifax, 10 cwt.; its specific gravity as low as 1·35, just sufficient to sink it very slowly, without any strain upon the rope while being paid out from the ship. Consists of one large solid copper wire, or conductor, wound round closely with fine iron wire. The whole enclosed in three thick coats of gutta percha, and bound round with strands of tarred string.

A "Pantographic Telegraph" has (according to the "Journal of the Franklin Institute," of Pennsylvania,) been invented [?] and patented by Giovanni Caselli, of Florence, in Italy. The claim is for a mode of rapidly transmitting the fac-similes of writings, drawings, ciphers, and arbitrary signs, in coloured characters, upon ordinary white or chemically-prepared papers. Also the mode of transmitting different dispatches at the same time, and with a single wire. Also the use of local piles, with circuit always closed, for the production of the characters in chemically-prepared paper.

Permeability of Submarine Cables.—At a recent discussion of the Institution of Civil Engineers some interesting facts bearing on this question were brought to notice. From practical tests, made by Mr. John Macintosh, on portions of the Atlantic Cable (supplied with a potassium wire in lieu of copper) he discovered that by immersing it in water for a continuous period of twenty-three weeks, and subjecting it to a pressure of 3 tons per square inch, it was perfectly insulated; but from this date the insulator appeared to deteriorate, and, at the twenty-fifth week, the moisture had reached the centre of the core, consequently decomposing the potassium. To obviate this difficulty, he immersed fresh pieces of cable in bisulphuret of carbon and the chloride of sulphur, which had the effect of closing up the pores and rendering the insulator thoroughly impervious to moisture—this, in fact, vulcanizing the insulating core to about 1-16th of its own thickness. In his new method of constructing telegraph cables, Mr. Macintosh relies, for imparting to them one material quality—viz., "perpetual isolation"—on the following process:—He applies to the insulating material [gutta percha or india rubber, incorporated on its outer coating with fibre,] a pressure of from 6 to 8 lbs. per inch at the time it is encased round the copper conductor. This pressure is obtained by passing the conductor between a series of powerful double rollers, similar to the mode of manufacturing circular rods of iron—and it is to prevent abrasion that the fibres are used—producing a body of such consistency and power of resistance against any alteration of form, as with a pure insulating substance, as gutta percha or india rubber, alone is not attainable. The finished cable, on leaving the last rollers, passes through a body of cold vulcanizing liquid, which has the effect of hardening the surface, and thoroughly closes up the pores, besides rendering the insulator proof against moisture and decomposition.

It is stated, as a well-known fact, that the 50 miles of Atlantic Cable regained last autumn were found to be electrically unserviceable, although recovered from a depth of not more than 140 fathoms.

Melbourne and Hobart Town.—Up to the 27th December ult. the screw steamship *Ormeo*, from London, with 240 miles of telegraph cable, intended to be laid between these points, continued to be lying in Plymouth Sound.

Constantinople and Gallipoli are now united by a telegraphic cable.

Cagliari [Island of Sardinia] and Malta.—A sudden stoppage of electrical communication between these places by the submarine wire (belonging to the Mediterranean Extension Telegraph Company) occurred during the afternoon of the 20th December ult., immediately after Cagliari had informed Malta that a violent hurricane was then blowing, and carrying everything before it; supposed to be from some vessel dragging her anchor at Malta. This interruption involves a delay of telegraphic news from India of two or three days, the distance between Cagliari and Malta being 300 miles. A subsequent test of the line at Cagliari led to the opinion that the fracture is about midway. Search operations were commenced on the 10th January ult. by the *Elba* off Malta, when an entanglement was found at the mouth of the bay, supposed to have been caused by a ship's anchor. Whether this has been the cause of the late interruption does not appear yet to have been ascertained, a gale of wind having for the moment prevented the further progress of operations.

Isle of Syra [in the Greek Archipelago] and the Phalera Harbour, at the Pireus. The electric cable for this line has been successfully laid down. The point of departure is the Tomb of Themistocles. Two English steamers did the work on the 10th December last.

Consumption of Zinc and Acid for [American] Electro-Telegraphy.—It is estimated that to work 12,000 miles of telegraph (the American system is here in question) about 3,000 zinc cups are used to hold the acid. These weigh about 9,000 lbs., and are decomposed by galvanic action in about six months; so that 18,000 lbs. of zinc are consumed in a year. About 3,600 porcelain cups are used to contain nitric acid, requiring 450 lbs. of acid to charge them once; and the charge is renewed every fortnight, making about 12,000 lbs. of nitric acid in a year.

The Atlantic Cable.—It has been announced (1st January ult.) that on the 19th or 20th December last some very good currents through the Atlantic Cable had been received at Valentia, including the name "Henley." Simultaneously from Liverpool intelligence from Newfoundland reported the renewed receipt of distinct signals at the latter place.

United States and Cuba.—Contracts are completed, and the works are to be immediately commenced at Savannah, Ga, for the construction of a telegraph line to Ferandina, Fla, thence by land to Cedar Keys, and from thence to Key West by a submarine cable. From the latter place a cable will also be laid to Cuba. The contractors were, according to the "Washington States," to leave New York (in December ult.) for the field of operations. The line to Key West would probably be completed by next summer, when it would be connected with Cuba as soon as the cable could be laid. The U.S. Government will thus have the means (considered as highly important) of prompt communication with their fleet now in the Gulf of Mexico, its head-quarters being at Key West.

Australian Telegraph Extension.—The arrivals and departures (of vessels) at Sydney, Adelaide, and Melbourne, are now (advices to 15th November ult.) posted daily at the offices of the Electric Telegraph Departments in all three cities, for the convenience of the public; and thus each market is kept in constant communication with the other. In a few months Tasmania will also be brought within the circle.

Sydney to Melbourne and Adelaide.—The electric telegraph between these places was opened on the 2nd November ult., and the three lines (open to the free use of all classes) were reciprocally in full operation. The three Governors exchanged complimentary messages.

A Heavy Thunderstorm, coming from the southward, so affected the telegraphic wires at Sydney as to stay for a time the transmission of messages between Sydney and Melbourne.

Australia and New Zealand.—Late advices by the Australian Mail state that a survey for this junction has been made, that the report is favourable, and that by means of a submarine cable, length about 1,350 miles, cost estimated at £180,000, the two colonies will shortly be (electrically) united.

Advices from Constantinople to the 5th January ult. state that the telegraph cable has been successfully laid to Constantinople and the Dardanelles. The operations for its prolongation to Candia and Egypt will be recommenced next spring.

The Magnetic Telegraph Company's underground wires between London and Liverpool, which pass through Birmingham, Willenhall, and Wolverhampton, are being taken up, and will be replaced by new wires, to be carried along the turnpike-roads, but underground through the towns.

Constantinople and Scutari.—Another submarine telegraph (it is also stated) will be laid between these points, the latter of which (Scutari) will be the head of the line to Bagdad. The Greek Chambers had voted 600,000 drachmas to connect Syra with the above telegraph communication.

A Chess Match by Electric Telegraph has been played between the Liverpool and Manchester Clubs. The moves commenced on the 12th January ult. The Manchester players were located in a commodious room on the first floor of the Electric Telegraph Company, with an instrument close at hand, attended by a couple of clerks.

Ragusa to Corfu, Zante, Candia, and Alexandria.—The question relative to this submarine telegraph line is now said to be definitely settled at Vienna between the British and Austrian Governments. It is supposed that the late accident to the Cagliari Cable induced the British Government to hasten the arrangements.

MARINE STEAM ENGINEERING, SHIPBUILDING, &c.

The Forty-five Gunboats Housed in Ordinary at Haslar, and the Slip-way.—That some of these once much-talked of boats are in a rotten state appears, from all accounts, to be undeniable—the very natural results of using ill-seasoned material, combined with hurried and consequently imperfect workmanship in the construction, and to the ultimate locating of the boats, which are placed in a "high and dry position," exposed to a kind of baking process in sheds roofed with corrugated iron. But that the whole of them might, on an emergency, be speedily again brought into efficient condition and placed afloat for active service, is likewise a fact which, thanks to some alterations which are now nearly completed, is equally apparent. An improvement has been made on the first formation of the incline of slip-way, by which a very objectionable and unsafe "jump" will be dispensed with. A considerable depth of mud at the lake end of it has been cleared away, forming a kind of basin, into or from which double the number of boats can be launched or hauled up in the same period of time as before, and with the same steam-appliances. An important addition has been made to the locomotive which draws the boats from the incline to the outside of their destined berths, or *vice versâ* Formerly the engine travelled, with or without its load, at the rate of only 50 yards a minute, namely, it returned with the cradle at this slow pace, after having deposited the boat in the shed, or transferred her on to the launching line of rails. By the adoption of a supplementary wheel, which is easily thrown into gear when extra speed is required, this rate is now increased fourfold—that is, when the cradle is unladen,—the immense power and same speed being still available as heretofore when the cradle has a boat on it: an important point, considering that the length of the traversing line of rails is exactly 505 yards. In order, however, to render the gunboat slip-way at Haslar perfectly available should the sudden services of the gunboats be required, still further improvements are needed, such as the removal of the mud, not only from the portion at the end of the line, but the deepening of the entire channel of the lake, forming it in fact into a commodious basin, and the substitution for Haslar bridge of a swing one, so that the boats shall not "hang-up" there, nor have to wait as hitherto for "tides," but be enabled to proceed at once to their destination.

Steamer Launches.—The *Jeddo* new iron screw-steamer, for the Peninsular and Oriental Company—builder, Laird, of Birkenhead—23rd December ult.; burthen, 2,500 tons; length 275 ft.; two direct-acting engines of 450 H.P., by Napier, of Glasgow. Will he fitted as the *Pera, Alma*, and other vessels of same line. Destined for the Australian mail contract.

The "Salto," Iron Steamer, for Monte Video, has recently been launched by Messrs. Thomson, of Glasgow. It has been built for the Company "Saltena," and is intended to run between Monte Video and Salto, in the Uruguay river. Length between perpendiculars, 155 ft.; breadth, 9 ft.; with oscillating engines of 90 H.P.

Portuguese War-Steamer Launch.—On the 8th January ult., a fine screw corvette, built for the Portuguese Government, was launched from the yard of Messrs. R. and H. Green, at Blackwall. She is a sister vessel of the ship that was built in the yard, and which conveyed the young Queen of Portugal, on her marriage, from Plymouth to Lisbon. She is named *Stephanie*, after the Queen: wood-built, 1,600 tons burden, pierced for twenty guns; with large swivel howitzer on deck, and to be fitted with a screw, worked by engines of 400 H.P.

A Steamer Collision, at Greenock, occurred 6 a.m. of the 8th January ult., in Cartsdyke Bay, eastward of Greenock, between the screw-steamer *Emerald*, 150 tons, and the screw-steamer *Auguste-Louise*, 115 tons, in which the latter vessel was so much injured that she settled down almost immediately. The *Emerald* (but slightly damaged) took the crew of the *Auguste-Louise* on board, and proceeded to Ayr two hours after the collision.

Steamboat Accidents in America.—Last year there were in the United States 47 steamers sunk, 19 burnt, and 9 exploded; 259 lives were lost, and property to the amount of 1,924,000 dollars was sacrificed,—and this on the western rivers alone. As compared, however, with the year 1857, there has been (in 1858) a decrease of about 11 per cent. in the number of steamer accidents, and of 4¼ per cent. in the number of fatal casualties.

Portland Harbour, [Maine, United States] the rumoured port selected for the *Great Eastern*, has been, from the first discovery of North America, known as the most commanding, safe, and accessible of the ports on the Atlantic coast. For the accommodation of ocean steamers, the city appropriated £12,000 to build suitable wharves, which are erected on the harbour-side of the Grand Trunk Railway. A channel is excavated, so that vessels drawing 30 fathoms of water can have access to them at any time of the tide. No port charges, harbour dues, or lighthouse fees at this port. Its actual longitude being to the east of Boston and New York, gives considerable saving in sailing distance. From New York to Liverpool is 2,869 miles; from Boston, 2,720; and from Portland, only 2,640.

The "Prince Albert" Steamer [Lever Line] made the run from land to land (from St. John's, Newfoundland, to Arran Island, Galway) in 5 days 16½ hours, having sailed on the night of the 10th December ult. from St. John's, and arrived off Arran Island at night on the 16th December.

The "Pera," with the heavy portion of the China and Calcutta mails (due the 20th December ult.), recently lost her screw just after leaving Gibraltar. The *Alhambra*, Peninsula steamer, took charge of her mails and passengers. The *Ripon* was sent to tow the *Pera* home.

The Screw Steamer, "Hood," Line-of-Battle Ship, 90 guns. Great efforts are being made at Chatham dockyard to complete this vessel, which has been on the stocks several years.

The American Steam Navy.—The President, in his recent message to Congress (delivered 6th December ult.), recommends an increase of steamers of light draught, in addition to the eight built last year. The cost of the "Navy Department," from the recent report of the Secretary for the year ending June, 1858, was 13,870,684 dollars.

The "London," 90 guns, it is understood, is to be converted into a screw-steamer, the Lords of the Admiralty having sent to the Devonport dockyard for a return of the cost of so converting her.

The Steam Navy of Great Britain in 1859.—The official annual return (published 1st January ult.) of the number of guns and tonnage of the whole of the vessels in the British Navy gives, at the beginning of 1859, 523 vessels, including screw-steamers of every description, exclusive of which there are 167 gunboats. The Channel squadron is composed of the following screw-steamers:—the *Royal Albert*, 121; the *Orion*, 91; the *Renown*, 91; the *Brunswick*, 89; and the *Racoon*, 22. The powerful steam reserve in harbour at Chatham and Sheerness consists of 36 line-of-battle screw-steamers, floating batteries, steam frigates, and other smaller vessels, all of which could be equipped for sea at the shortest possible notice. There are also 11 line-of-battle screw-steamers of from 80 to 131 guns each, building at the several royal dockyards, together with 15 other screw-steamers, all in various stages of progress. The majority of steam gunboats, nearly the whole of which are described as ready for service, are of 60 H.P.

Steam Communication with Jamaica [Extension].—A Bill for this object is now before the Legislative Council of the Island.

The Galway Steamers to America. The Lord-Lieutenant has again been waited upon by a deputation (consisting of peers and members of Parliament, the Lord Mayor and Lord Mayor elect of Dublin, members of the Dublin council, bankers, merchants, &c.) on the subject of the Galway Packet line. To the solicitation for Government support to the Lever enterprise His Excellency returned, as before, a gracious but guarded reply, expressing his well-wishes towards the undertaking, but intimating that there were difficulties in the way, and other parties to be consulted "before a subsidy could be granted by Government for the purpose of bolstering up a commercial enterprise."

The Liverpool (Inman's) and the "Canadian" Mail Steamers.—A correspondence between Mr. Inman, the proprietor of the *City of Manchester*, and other screw-steamers running from Liverpool to New York, and the Postmaster-General has been placed recently in the Liverpool News Room, and excited a good deal of attention. Mr. Inman states that he is under contract with the Postmaster of the United States to carry the United States mails every fortnight from Liverpool. The Postmaster-General at London replies that he was aware such was the case, and that arrangements had been made to send the mails in the usual form by Mr. Inman's steamers, but that lately a communication had been received from the United States Postmaster, to the effect that a contract had been entered into with the proprietors of the Canadian steamers, and that the mails were to be sent by those steamers when they sailed from this country.

The Russian Steamer *Dnieper*, formerly the *Dutchman* (Russian Navigation Company, from London to Odessa), struck, 4th January ult., on a rock, 10 miles north east of Gallipoli, within the Dardanelles. Nearly a total loss.

The Gunboat "Shamrock" steamed outside Plymouth Sound, on the 8th January ult., to try her engines.

The New Screw Steam-Frigate "Forte" is being fitted in No. 2 Dry dock, Sheerness.

The "Franklin," formerly reckoned as a 74, is now rebuilding into a screw of 54 guns, at Portsmouth.

Of Steam Line-of-Battle Ships carrying from 60 to 131 guns, and propelled by force varying from 200 to 700 H.P., England has 52, France, 33; Holland, 1; Austria, 1.

War Steamers at present (1859) building for the British Navy.—From the official quarterly return just published by the Lords of the Admiralty, it appears that there are eleven line-of-battle ships, with an aggregate of 1,133 guns, now being built at the several royal dockyards—many of them in a forward state for launching—viz., at Portsmouth, the *Duncan*, 100; the *Royal Frederick*, 116; the *Prince of Wales*, 131; the *Victoria*, 121;—at Devonport, the *Gibraltar*, 101;—at Chatham, the *Atlas*, 91; the *Hood*, 90; and *Irresistible*. 80;—at Pembroke, the *Howe*, 121; the *Defiance*, 91; and the *Revenge*, 91. There are also fourteen first-class screw steam frigates and corvettes on the stocks, including the *Aurora*, 51 guns; the *Immortalité*, 50 guns, at Pembroke;—the *Narcissus*, 50; and the *Jason*, 21, at Plymouth;—the *Ariadne*, 32, at Deptford; the *Galatea*, 24; and the *Barossa* 22, at Woolwich;—and the *Charybdis*, 22; and *Orpheus*, 21, at Chatham.

THE STEAM-LINER NAVY OF FRANCE (WAR SHIPS OF THE FIRST CLASS) consists now (1859) of six 84's, sixty long 30-pounders, and fifty-four 30-pounder Paixhan's.

THE "EMPEROR," 100, is the only AUSTRIAN SCREW LINER now afloat, though two others are building—one at Venice and one at Pola.

THE CHATHAM AND SHEERNESS STEAM-RESERVE.—A return recently made of the line-of-battle steamers and other vessels comprising the steam-reserve at these places, shows that there are at present in reserve 8 line-of-battle screw-steamers, 4 floating batteries, 6 screw-corvettes, and 18 steam-frigates, and other vessels—viz. (attached to the steam-reserve): The *Royal George*, 102; *Hero*, 91; *Cressy*, 80; *Mars*, 80; *Colossus*. 80; *Meeanee*, 80; *Majestic*, 80; *Amphion*, 36; *Scylla*, 21; *Cadmus*, 21; *Goliath*. 80; *Emerald*, 51; *Bacchante*, 51; *Challenger*, 21; *Clio*, 21; *Scott*, 21; *Cossack*, 20; *Malacca*, 17; *Fawn*, 17; *Etna*, 16; *Thunderbolt*, 16. Floating-batteries:—The *Miranda*, 15; *Thunder*, 14; *Trusty*, 14; *Eurotas*, 12; *Victor*, 6; *Phœnix*, 6; *Dragon*, 6; *Driver*, 6; *Alacrity*, 4; *Foxhound*, 4; *Snake*, 4; *Reynard*, 4; *Wrangler*, 3; *Fearless*, 3; *Locust*, 3; *Wye*, 3. Aggregate tonnage, 100,000 tons; number of guns, 1,113.

FRENCH WAR STEAMERS NOW BUILDING.—During the last seven years the number of French steam-ships of war has been more than double (being 114 in January, 1852, and 230 in January, 1859), and the number of steam line-of-battle ships raised from 2 to 32. At the present moment 8 ships of the line and 25 frigates and smaller vessels are building in the French dockyards. The line-of-battle ships are—the *Intrepide*, *Ville de Bordeaux*, *Ville de Lyon*, *Gloire*, *Invincible*, and *Normandie*, of 900 H.P. each, and the *Massena* and *Castiglione*, 800 each. The *Gloire*, *Invincible*, and *Normandie* are to be sheathed with thick iron plates. Two other ships of the line, the *Friedland* and the *Bayard*, are to be converted into screws.

A SCREW STEAMER FOR THE BALTIC TRADE is now building by Messrs. Earle, Hull, 1,000 tons burthen, as also two small steam-tugs for the Liverpool and Leeds Steam Navigation Company.

SOME LARGE STEAMERS FOR THE ATLANTIC ROYAL MAIL COMPANY are now building by Martin Samuelson and Co., iron shipbuilders, of Hull. They are of equal size, viz.:—length, 330 ft.; beam, 38 ft.; depth, 24 ft.; nominal H.P., 600; on paddle principle; guaranteed speed, 20 miles per hour in still water.

LIFEBOATS.—A gentleman from the Government of the Canton of Geneva (M. Antoine Mermilliod), has just come over to this country, with introductions to the Royal Humane Society, in order to obtain a lifeboat for the Lake of Geneva. He has, in accordance with the instructions of his Government, intrusted the superintendence of her construction to Frederic Young, Esq., C.E., under whom she will be built and equipped by the Messrs. Forrestt, the well-known lifeboat builders, of Limehouse.

THE MAIL-STEAMER "QUEEN," from Calais, in proceeding for Dover Harbour (20th January ult.), grounded on the rocks near the South Pier, but was afterwards got into the Harbour. when her stern compartment filled, and her stern remained submerged.

THE FRENCH STEAMER "MADINIA" has, according to accounts from Bona of the 3rd January ult., been totally lost on the rocks off that place during the late disastrous gales in the Mediterranean.

THE "TRAFALGAR," 120, sailing line-of-battle ship, which is being altered into a 91-gun screw-steamer, at Chatham dockyard, has a large number of shipwrights employed in getting her keel into place. Preparations are now being made for the reception of her machinery (800 H.P.) by the beginning of March.

THE LARGEST IRON VESSEL EVER BUILT AT LIVERPOOL.—THE "SLIEVE DONARD," 1,450 tons burthen, classed A 1 for 12 years, built for Sinclair and Son, of Belfast, for the India trade, was launched (20th January ult.) by Messrs. Vernon and Son, from the yard, Liverpool.

MILITARY ENGINEERING, &c.

THE NEW GUN-CARRIAGE, recently finished in the carriage department of the Woolwich Arsenal, for mounting the curious ornamental piece of ancient ordnance (supposed to have been a wall-piece at the entrance of the Royal residence of the former Rajahs of Sarawak, and now destined for the Royal Armoury at Windsor Palace) has been pronounced one of the most perfect specimens of the (carriage-building) art hitherto turned out of the Arsenal. The limber, carriage, wheels, &c., are made of solid Spanish mahogany, and are elaborately decorated with ornamental and filigree work in bronze-leaf. The wheels edged and capped with bronze, dolphin-pattern. Woodwork highly polished and varnished, and cemented together with such precision that it is difficult to discern the spots where the timbers are brought together. Designed and manufactured by Mr. Morris, the master-wheelwright in the carriage department of the Arsenal.

FRENCH GUNBOATS [NOVEL CONSTRUCTION].—Orders, it is asserted, have reached Toulon from Paris, to build eight new gunboats immediately. These boats will be so made as to take to pieces, like a dissected map, and be readily put together again.

ARMSTRONG'S LONG-RANGE GUNS v. FLOATING BATTERIES.—On the 5th January ult., the *Trusty* floating-battery underwent at Shoeburyness flat the test of Armstrong's 32-pounder long-range gun, fired from the *May Flower* steam gunboat, at ranges varying from 200 to 400 yards. The gun, which loads at the breech, was charged with a 6lb. cartridge, and one of Armstrong's newly-invented shot, about 10½ in. long and about 4 in. in diameter, covered with lead, the outer-end much resembling the circular end of Hall's rockets, others of the shot form a square of about an inch and a half. Barrel of the gun, rifle-fluted down to the chamber. Target marked chequered, taking in three parts of the broadside. Some common shot were fired, none of which exceeded 400 yards,—and started the plate-bolts, woodwork inside the plates, beam-knees, decks, &c. Several rounds from one of the newly-invented shot, steel pointed, were then fired. A subsequent careful examination of her hull has shown that only two or three of the Armstrong-shots appear to have done any very serious amount of damage. In one instance, the thick iron plate at the side was split, and the ball penetrated through the woodwork; and two other shots penetrated the iron sides of the battery, the majority, however, having made but trifling impression on the ship's side. Another trial, of a larger description of shot, is to be made on a floating battery, which will be put to a much severer test.

THE 12-POUNDER AT SHOEBURYNESS passed, at 800 yards distance, one of the newly-invented [Armstrong's] shot through a solid body of oak-timber 9 ft. thick.

MANUFACTURE OF GUNPOWDER.—A fatal explosion occurred recently at the Gunpowder Mills of Messrs. Curtis and Co., at Hounslow. A workman was engaged mixing and making powder at a table with what is called a "paddle," that is, an instrument made of copper, with a long handle attached, which is used to rub down the composition. While he was employed, one of the other men (who narrowly escaped with his life) saw, as he states, a spark come from the "paddle," and, immediately, the explosion took place. Four mills were destroyed, the whole being shattered to pieces. One man was killed, and two others injured. The operation which occasioned the accident can, it is stated, be as well performed by the composition being in a wet as in a dry stated; it is therefore suggested that the "paddle" shall be so formed as to act as a syringe by means of a spring placed at the top of the handle, so that the "paddle" can be kept constantly discharging water, the quantity being left to the discretion of the operator, who would have control over it by the spring or tap.

TERRY'S BREECH-LOADING RIFLE having passed the tests of the Small-Arm Committee, is, by order of the Secretary of State for War, to be supplied immediately to several cavalry regiments. The carbine, it is stated, may be loaded with facility at the time of a horse being at full gallop, because neither biting the cartridge nor a ramrod is required, and there is no risk of blowing off the hand while loading.

FRENCH ARTILLERY OPERATIONS AT SEBASTOPOL.—General Niel, of the French Engineers, in his lately published "Journal of the Operations of the Siege of Sebastopol," states, that during the siege, which lasted 334 days, the French artillery threw into the town 510,000 round-shot, 236,000 shells from howitzers, 350,000 shells from mortars, and 8,000 rockets: during the war the French infantry fired 25,000,000 of cartridges.

THE PARIS MILITARY SCHOOL [ECOLE MILITAIRE] is, by an Imperial Decree, about to be considerably enlarged. The works of the new buildings, which will stand on the Place Fontenoy and the Avenue de Saxe, are to be begun immediately.

THE CASTLE AT MILAN, which is in the midst of the city, has been declared a fortress, and the owners of the adjacent houses have received notice that their tenements are liable to be demolished at the requisition of the military engineers.

SCUTTLING A BURNING VESSEL BY ARTILLERY.—The *Isaac Wright*, emigrant vessel, took fire in the Mersey, 23rd December ult. All the passengers having been safely brought off by the tugs, and the engines brought to play on the vessel appearing to have no effect on the fire, which seemed every moment to increase instead of being subdued, the burning ship was brought as close to the shore as the state of the tide would permit; and an application was made to Captain Mends, of H.M.S. *Hastings*, for the purpose of having the ship fired into, as the more speedy and effectual means of scuttling her. This was done, and the vessel was soon sunk, but in such a position that at low water she was left high and dry. The "Liverpool Post" subsequently (1st Jan.) adds:—"Strange to say, now that she lies dry, it is apparent that not a single shot (the guns were fired into her at a short range) penetrated her hull;" and suggests the question, "Of what use are such guns in naval warfare, and more particularly when war-ships are built of stouter timber than the merchant service?"

THE FORTIFICATIONS OF DOVER HARBOUR, lately visited for the purpose by Sir J. Burgoyne, are to be considerably strengthened and improved. His plan for a more complete and comprehensive fortification of the harbour and its surrounding coast, will be shortly carried out.

PRUSSIAN WAR PORTS, &c., IN THE BALTIC.—A fortified harbour is to be constructed in the capacious Eastern Bight (Bodden) of the Isle of Rügen, and a communication is to be opened with the Baltic, by cutting through the Northern Sandbank into the exterior bay, or Tromper Wick. Prussia, ever since the campaign in Holstein, feeling the necessity of creating a fleet in the Baltic, is now making the attempt in earnest.

BATTERY PRACTICE.—LONG-RANGE FLOATING TARGET.—The *Trusty*, 14, floating battery, has been (January ult.) towed from Chatham to Shoeburyness by the *African* and *Adder* steam-vessels, to be moored several miles out at sea, to serve as a floating target for the guns from the long-range practising battery at Shoeburyness.

WARRY'S NEW BREECH-LOADING GUN (noticed in a recent number of our Journal) still continues to be experimented upon at Chatham, and has lately attracted much attention. The gun is made to fire ten rounds per minute; and on one occasion fifty rounds were fired in seven seconds less than five minutes, the shot at each discharge striking an object placed at 100 yards distance. An opening at the breech admits a current of air to pass through the gun, thus effectually preventing the heating of cannon caused (on the old system) by incessant firing. A model, of larger dimensions than the first, is in preparation at the establishment at Brompton. It is to be of brass, with wrought-iron casings (the former one was wholly of brass), 18 in. in length, the interior of the bore being rifled on the Enfield-rifle principle; the ball to be the conical-shaped rifle bullet, covered with a composition coating of a peculiar character. The balls (according, at least, to the inventor's confident belief) are to be thrown (ten per minute) fully 2 miles, doing effective execution at 1,000 yards. Entire weight of the gun, 10 lbs.; the muzzle capable of being pointed in any direction without moving the carriage.

THE NEW "ELONGATED RIFLE-SHOT," the invention of Captain Norton, is stated to possess several important advantages over the conical rifle-balls now in use, there being no "plug" in the base, and the ball being coated with paper, whereby the great amount of friction which prevails in the propulsion of the bullet from the barrel is considerably lessened.

LA VENDÉE.—A fort is immediately to be constructed on the Hill of Pierre Levée, in the Isle Dieu, in La Vendée. The works will costs 900,000 francs.

A NEW BATTERY, it has been decided by the War Office, is to be erected on the Lighthouse Island at the MUMBLES, in Swansea Bay. It is to be a powerful one, armed with heavy guns, and destined to protect the numerous shipping which run into the roadstead for shelter. Colonel Vicars, in 1854, surveyed this site, which during the last war with the French was used by the Admiralty as a rendezvous for the merchantmen of the whole British Channel, whence the vessels were escorted to various parts by men-of-war.

NEW BATTERIES AT TILBURY FORT AND GRAVESEND are, by order of the War Department, to be erected forthwith. Notice has been issued for tenders for constructing the requisite gun-sheds, &c.

HYDRAULIC ENGINEERING, &c.

BY THE NEW "HYDRAULIC LIFT" a speedy and efficacious means of docking and undocking a ship for the purpose of examination, during all phases of the tide, in about two hours, is afforded. The plan consists in sinking a hollow buoy, or pontoon, under the ship to be docked, and afterwards raising the buoy, ship and all, bodily out of the water by hydraulic power. The pontoon having become clear of water, the valves are closed—one watertight—and the apparatus towed away to some suitable position, with the ship on it, high and dry. The Victoria Dock Company have lately adopted it. Their graving-dock works, recently completed for this purpose, occupy about 10 acres of water. Dry docks on the old system could only be entered or left at high water; and the consequent delay was frequently productive of great loss and inconvenience.

THE HYDRAULIC RAM, now in general use for operations requiring extra motive power, is considered to be the most ready, simple, and effective mode of concentrating the action of mechanical forces.

WATER SUPPLY—(METROPOLITAN AND PROVINCIAL).

CITY OF LONDON PUBLIC DRINKING FOUNTAINS.—At a Special Court of Common Council, held 20th December ult., it was (on the motion of Mr. Anderton) referred to the City Lands Committee to examine and report upon the desirability of erecting, for the benefit of the working and labouring classes, drinking fountains within the City of London, with power to confer with the Commissioners of Sewers thereon, and, if necessary, the Metropolitan Board of Works; likewise as to the best sites, the cost, annual expense of maintenance, &c. The advantages which had accrued to the people of Liverpool, Derby, and other large towns, from similar erections, were alluded to.

IN MARYLEBONE, PUBLIC DRINKING FOUNTAINS are, by resolution of the Local Representative Council (1st January ult.), to be erected, in compliance with the beneficent proposition of Mr. Gurney, noticed in our last, to erect four of such fountains at his own expense, the vestry naming suitable sites. These sites, as finally selected, are—Regent-circus, Oxford-street, Edgware-road (near Chapel-street), Marylebone-road (opposite Trinity Church), and Clarence-gate (Regent's-park). The water to be provided and the fountains maintained in perpetuity at the expense of Mr. Gurney; the lighting to be paid for by the vestry. The water is to be passed and filtered through a bed of charcoal, so as to be thoroughly pure (?)

The First Metropolitan Drinking Fountain will, therefore, be erected at the Regent-circus, opposite the Rest, on the St. James's side.

The Sinking of an Artesian Well was, at the Parochial Representative Council, above alluded to, suggested (by Mr. W. Williams, M.P.) as the only way to obtain pure water for these drinking fountains, "as no pure water could, at present, be obtained from any of the public companies;" the only plan was to dig down below the blue clay into the chalk formation of London.

At Bristol, Mr. Robert Lang has offered to give £100 towards the erection of a drinking fountain to be erected opposite the Fine Arts Academy, near the Victoria Rooms, Queen's-road.

London and Paris [compared].—London is at present supplied with water by ten independent companies. Chief sources of supply—the River Thames and River Lea. The first supplies five of the companies daily with 35,372,782 gallons; the latter supplies two of the companies daily with 41,000,000 gallons. The remaining three companies take their supply (4,653,000 gallons) from the River Ravensbourne, and the ponds and chalk wells of Hampstead, Plumstead, and Woolwich. Steam-power (applied to pumping) employed for its distribution, nominal H.P., 7,254. Length of mains and branches, 2,086 miles. Area of subsidy reservoirs, 141 acres; of filter-beds, 40 acres. Number of houses supplied, 328,561. Gross quantity supplied per day, 81,025,842 gallons. Entire cost of the several works, in 1856, was £7,102,823; showing, for every pound expended, a daily supply of 11·4 gallons.

Paris.—Sources of supply (expense of works and distribution defrayed by the Municipality):—1. The Canal d'Ourcque, by gravitation, it being 52 metres above the level of the sea, and about 20 metres above the lowest point of Paris. 2. From the River Seine, whence it is pumped by steam-engines, and raised to the varied height of 75·30, 72, and 66·24 metres above the level of the sea; and to 43·30, 40, and 34·24 metres above the lowest levels of Paris. 3. From the artesian well of Grenelle, the basin of which is 90 metres above the level of the sea. 4. From the aqueduct of Arcueil, the reservoir of which is 57·39 metres above the level of the sea. And 5. From the sources to the north, at a much greater elevation, and which furnish but little water. Total length of the principal conduits, 218,213 metres; of the smaller pipeage, 190,048 metres, or to a total of 408,254 lineal metres, or about 253·6 English miles. Length of conduits of the water d'Ourcque, 281,525 metres; of all the others, 126,729 metres. Whole length of the streets of Paris, about 400,000 metres, which is less than the extent of pipeage; but there are many streets without water, while there are several others with a double pipeage. During the hot weather of last year the water-consumption rose to about 120,000 metres cube—viz., from l'Ourcque, about 100,000 metres cube; and from other sources, 20,000 metres cube. Daily supply, about 24 gallons to each individual inhabitant, or 26,350,000 gallons, the quantity of water daily sent into Paris.

Thames Water—Periodical Test.—At a recent meeting of the Metropolitan Board of Works, the Main-Drainage Committee reported (*inter alia*) that they, the Committee, had entered upon the consideration of the reference of the Board, instructing them to report as to the best means for ascertaining the flow of water over Teddington Lock, and, approximately, the quantity of fresh water from the tributaries of the Thames between Teddington and Barking, more particularly in dry weather; and as to the most effectual means for ascertaining, from time to time, the chemical condition of the water, and depth of mud in the Thames, at various points of the river.

Fresh Water for Ships at Sea.—By direction of the Board of Admiralty, some highly-interesting experiments have recently been made at Portsmouth to test the relative merits of the apparatus invented by Sir R. Grant, and that of Dr. Normandy, of London. The first experiment was made (15th January ult.) on board the *Sphynx*, in the steam basin. The quantity of water produced by Dr. Normandy's apparatus was 92 gallons, with a specified quantity of coals. With same quantity of fuel, under same conditions, and with same boiler, Sir R. Grant's apparatus (under the superintendence of Mr. Miller, of the condensing department), on board the *Erebus* (20th January ult.), produced only 32 gallons of water. The difference in the quality of the water produced is this, that Sir R. Grant's is purely distilled water, whereas the other becomes aërated in the process of distillation, and is perfectly cold and fit for use when it leaves the apparatus. At present, we believe, all the large war-steamers are fitted with Sir R. Grant's apparatus.

BOILER EXPLOSIONS.

A Fatal Locomotive Boiler Explosion, attended with the loss of two lives (the engineer and his son, a boy 9 or 10 years of age), and severe injury (scalding, &c.,) to three others, occurred 20th December ult., on the Hetton railway, county of Durham. The locomotive was an old engine—the oldest on the line, or in the employment of the Company. The railway plates were torn up for some distance, and broken to pieces. The deaths of the engineer and his son were instantaneous, their bodies being blown nearly 100 yards from the spot.

A Boiler Alarum, says the "Scientific American," has been contrived by Alexander Miller, of Cleveland, U. S. A ball floats on the surface of the water inside of steam-boilers, and rises or falls as the level of the water varies. A whistle is blown by the escaping steam whenever the water falls below the tubes, so as to endanger an explosion when cold water is suddenly introduced.

Demerara.—A fearful accident occurred (16th December ult.) on Plantation Lusignan, East coast, by the boiler of the draining-engine exploding, in consequence of the engineer incautiously introducing cold water into the boiler when it was heated and nearly empty. Engine-house destroyed, and four men (including the engineer) killed on the spot, besides a number of others severely injured.

GAS ENGINEERING—(HOME AND FOREIGN).

A Remarkable Gas Explosion occurred Sunday morning, about half-past 6, in West Percy Street, North Shields, whereby the residence of Mr. Walter Mitchell, ship-owner, was nearly reduced to a wreck. The chandelier in the back parlour had been pulled beyond the water joint, and had leaked all the preceding night, the gas not having been turned off at the meter. In the morning the servant-girl had gone into the parlour with a lighted candle; the consequent explosion knocked the girl down, smashed through a partition wall, and burst the windows of both the back and front parlours into the street, smashing every article of furniture in its progress. In a bedroom it tore away the curtains from a bed, set fire to the paper on the wall, and, bursting out of the bedroom window pitched a looking-glass and other articles to the opposite side of the street; but the inmates escaped comparatively unhurt, though the panels were forced out of the doors and the roof injured.

London Gaslights.—At a recent court (11th January ult.) of the City Commissioners of Sewers the unsatisfactory state of the gas supply and lamps throughout the City formed one of the subjects of complaint, several members stating that the gas supplied to private houses, as well as to the public lamps, had lately been deficient in quantity and inferior in quality, notwithstanding that the last year or two the Commission had paid a much larger amount than formerly for lighting purposes; that the amount of light in the public lamps had not exceeded that of the old oil-lamp in many instances; and that the lanterns were in such a filthy state that the little light they contained was nearly obscured, &c., &c. The clerk was ordered to call the attention of the contracting company to the matter by letter.

The Lighting of the Corona of the Dome of St Paul's Cathedral with jets of gas has, for the special evening services, been (officially) stated to cost £1 per hour.

An Experimental Monster Gas Arrangement, for improving the lighting-up of Covent Garden Market, has been erected by order of the Duke of Bedford, and (21st January ult.) lighted for the first time. The new light consists of a number of gas-jets around a central pillar. It is apparently too concentrated and, in proportion to the space lighted, will probably be found too expensive.

A New [Borough of Marylebone] Gas Consumers' Company has been started, designed to supply the district in question with gas of superior quality at 4s. per 1,000 ft. The works will be at Greenford, about 3 miles from Harrow.

AGRICULTURAL MACHINERY.

A Guideway Steam-Agriculture Company [Hackett's Patent] is being formed. The system, by which the whole series of agricultural operations has been performed, requires the farm to be worked upon to be completely, regularly, and systematically laid with railway lines, on which carriages are drawn by steam-power, to which carriages the ploughs or other machines intended to be used are fixed; in other words, it consists "in laying down, at intervals of 50 ft. or more, permanent guideways or rails, by which means a locomotive cultivator, carrying the motive power, is supported and guided; and to the under-side of which are attached the various implements to be used. On the headlands are other rails at right angles to the former, upon which a shunting or traversing carriage moves, by which means the cultivator is transferred from one set of rails to another, or is brought to the homestead, where the engines can be used for thrashing, or other barn operations. The estimated cost (stated to be based on work which has already been repeatedly performed) is as follows: Annual rent of the rails put down at £1 4s. per acre per annum for a farm of 700 to 1,000 acres, or £1 10s. for market-ground near London; cost of the engines and implements set off against the same for horses, not one quarter of the same by horse-power; cost of the guideway or rails, in creosoted timber, £10 per acre; in hard brick and angle-iron, £20 per acre.

Movable Iron-huts for Rook Boys have been recently exhibited at Dover. The material is corrugated iron; the form circular, with a diameter of 2 ft. 8 in; and about 5 ft. high, running on two wheels, with barrow-handles, and so light that a child may wheel it from one part of the farm to another.

BRIDGES, VIADUCTS, &c.

The Suspension Bridge over the Seine, at Evry, which had been just completed, fell recently with a tremendous crash. This bridge was intended to unite the villages of Loisy-sous-Etoiles and Evry, in the arrondissement of Corbeil. Workmen were employed in placing on the bridge a great amount of weight, necessary to test its strength, and eight of them were still on it when a loud crash was heard: an iron rod gave way, and the whole structure fell into the river, carrying with it the eight men, who, however, by timely aid were all got out of the water, one having a leg fractured, and the others being severely contused.

The large Railway Bridge near Creutznach fell on the night of the 28th December ult., in consequence of the inundations of the Nahe river.

The Deepdale Viaduct, thrown over a precipitous valley intersecting the South Durham and Lancashire Union Railway, has just been completed. Designed by T. Bouch, Esq., C.E., of Edinburgh, the engineer to the line. Structure (with exception of foundation), wholly of iron. Foundation stone laid in 1857. First column erected 12th August, 1858. Last girder fixed 2nd December. Viaduct 220 yards long, and 155 ft. high. Contains from 500 to 600 tons of cast-iron: of wrought-iron 300 tons; the whole of which was erected without scaffolding of any kind, in less than four months: not the slightest accident occurring, a fact almost unprecedented in similar works. Contractors for the iron-work, Messrs. Gilkes, Wilson, and Co., of Middleborough-on-Tees. For the masonry, Mr. Appleby, of Barnard Castle.

The Beelah Viaduct will not be commenced until the middle of the present year.

The Lune Valley Railway Viaduct, of which the first stone has just been laid, is situated at Low Gill, and is to be called the *Dillicar Viaduct*. Engineer, J. E. Errington. To consist of 11 arches of 45 ft. span, more than 100 ft. in height, and containing upwards of 400,000 cubic ft. of masonry. Contractor, Mr. Buxton.

The "Victoria and Pimlico Railway Bridge" across the Thames is in rapid progress. The cofferdams for the abutments and piers are being erected; and nearly 40,000 cubic ft. of timber have already been driven for that purpose, by two steam pile-engines and eight smaller ones. The sites of all the piers have been dredged down to the clay by steam-dredgers. Nearly 10,000 cubic ft. of stone are now upon the ground. The foundations have been put in for the abutment on the north side of the embankment leading to Chelsea suspension bridge, and in a short time they will be brought up to the surface of the ground.

The Railway Bridge of Kasr Zayat across the Nile must be finished by June, 1860. It is a splendid work, and bids fair to be one of the wonders of the modern world.

A Light Hunter's Bridge, of timber, and for the accommodation of the hunters, about a mile below the town of Berkeley, has lately been erected by Sir Maurice Berkeley. About 108 ft. long, on poles; width (at centre), 26 ft.; draws back on one of the approaches like a telescope, to allow of shipping passing to and fro; and is only put across on hunting days. It takes one man three minutes to work it over.

The Saltash Railway Bridge, near Plymouth, is in a forward state. The land piers are now completed on the east side of the river, and preparations are being made to hoist the roadway girders on them, thus completing the outline of the bridge from east to west.

HARBOURS, DOCKS, CANALS, &c.

The "Madras Irrigation and Canal Company" have obtained the Government guarantee of a minimum interest of 5 per cent., and an Act of Incorporation.

New Docks at Greenwich, in connexion with the South-Eastern Railway, are announced. Proposed site, between Greenwich and Woolwich, adjoining the Angerstein Branch of the South Eastern Railway, and having entrances from the Thames at Greenwich on the west, and Charlton on the east. The entrances to consist of locks, 90 feet and 50 feet in width. The three docks first to be constructed will comprise an area of about 48 acres of deep water, in addition to which land will be taken for quays, graving-docks, warehouses, timber-ponds, &c. Total length of frontage for dock-quays, about 9,200 feet. Cost estimated at £500,000, or £10,418 per acre of water. A steam-ferry, in connexion with these docks, is to afford convenient access, by means of the Blackwall Railway, from the eastern district of London.

Dock Accidents to Shipping, and Compensation.—The Mersey Dock Board have recently awarded payment of two sums (£306 and £3 15s.) as compensation claimed by two firms for damage sustained by vessel owned by the latter. On the 7th October, the vessels were lying in the Canada Dock, when, in consequence of a defective mooring-ring, they got adrift, and the wind being high, they came in violent contact with the masonry.

Two Lofty Travelling Cranes, to cost £500, for loading-carts, &c., have been ordered for the same docks. It is believed that from the unusual height of these new machines, and from the ground being less encumbered than with ordinary cranes, the traffic of the docks will be greatly facilitated.

Liverpool Docks (Extension).—On the 15th January ult., the new Dock Board resolved, at a special meeting, to apply to Parliament for power to borrow £300,000, for the purpose of improving and extending the Liverpool Docks.

Milford (New) Docks.—To improve this place as a port of arrival and departure, docks are to be constructed on an extensive scale. Hubberstone Pill, in the first instance, is to be inclosed at an expense of £100,000. A Company has been formed for the purpose. Steam communication is to be established between Milford, Neyland, the dockyard angle, and Dale, with steam-tugs for the harbour.

Hakin.—The present dry-dock at this place is also being enlarged.

The "Napoleon Docks" (a speculation hitherto remarkable alike for its boldness and the misfortunes of its early career) have again some chance of resuscitation, M. Emile de Girardin having accepted, without salary, the post of manager. He proposes to buy up the old shares of 125 fr., which have lately been fetching only 40 fr. in the market, at 65 fr. for money, or to give shares in the newly-organised Company at the rate of 85 fr.

The Erie Canal.—The Governor of the State of New York (advices to 5th January ult.) proposes in his recent annual message to deepen the whole of the channel of the Erie canal to the depth of 7 feet, and leave the portion not yet completed at a width of 45 feet. Likewise to secure 6 feet of water on the Erie, Oswego, and Cayuga and Seneca canals, and proceed with the permanent work through Cayuga marsh during the coming winter. He regards the Erie canal as incompatible with any other means of transportation through the State, especially when steam shall be successfully applied in its navigation.

New Ship Canal through the Isthmus of Kraw (Siam).—A watercut of twelve miles across a portion of the Malayan Peninsula, whereby a saving of 1,175 miles will be effected in the distance between Calcutta and China, is in contemplation by the British Government, in conjunction with the authorities of Siam. From a recent communication on the subject from Sir John Bowring to Lloyd's, it appears that this important project of uniting, by a ship canal, the two bays of Bengal and Siam, is in a fair way of realisation. The Chamber of Commerce at Bombay have decided in its favor; and the initiative operations are only delayed by the illness of Sir Robert Schomberg, the British Consul at Siam.

Our Government Dockyards.—The anomalous system of Government management in our dockyards is becoming a topic of severe comment, more especially amongst our great shipbuilding firms. At a recent discussion "On Naval Architecture," at the Society of Arts, Mr. Scott Russell stated that, by order of the late Board of Admiralty, a report had been drawn up by a committee, as to the principles on which the future fleets of England were to be constructed. The existence of this report naturally produced great anxiety in himself and others like him engaged in naval architecture to procure a copy. He tried every means to obtain one, and failed. But at last he succeeded, and did get one from the Continent. Another remark made on the occasion was, that foreigners (Russian officers in particular) have authority to pass freely over our dockyards, while Englishmen have to go about under the surveillance of a policeman.

Jarrow.—The docks constructed by the North Eastern Railway Company at Jarrow Slake are so far completed that the water has just been let in through the sluices at the north end of the works. The directors celebrated the event by the firing of cannon, &c. The dock and tidal basin will contain about 50 acres of water, sufficient for the accommodation of between 400 and 500 vessels. The tidal dock 100 ft. in width, and upwards of 250 ft. in length, with entrance-gates 60 ft. wide. Tidal-entrance 80 ft. in breadth, and will admit ships of large size. Depth on the dock-sills at high tide 24 ft. 6 in.; ditto on the inner area 24 ft. The docks are to be used as a place of shipment for coals by the North Eastern Railway Company. At the landward end are four jetties, stretching far inward, each having five shipping places at each side. Ballast jetty fitted with four of Armstrong's powerful hydraulic cranes. Consumption of timber, for jetties alone, from 300,000 ft. to 400,000 ft. Quantity of ashlar work in freestone, upwards of 600,000 cubic ft.; of granite, from 15,000 to 20,000 cubic ft. Rubble masonry, 80,000 cubic yards. The cellular iron gates of the 60-ft. tidal dock and 80-ft. tidal entrance, manufactured by Messrs. Robert Stephenson and Co., Newcastle, weigh from 500 to 600 tons, worked with hydraulic power. Earth removed in the construction of the docks, 2,000,000 yards, principally silt.

Kingston Harbour, Jamaica.—A Bill for the erection of a patent slip dock in this harbour has been read a second time (advices to 27th December ult.) in the Legislative Assembly.

Apprenticeship in Chatham Dockyards.—The half-yearly examination of candidates has just been completed at this establishment. About thirty youths underwent the competitive examination for entries; the names of the successful candidates being forwarded to the Admiralty for approval.

The Kedrillis Canal for the Navigation of the Danube.—The report of the [Paris] International Technical Commission, which was to pronounce on the different plans proposed by the local (European) engineers, to render the mouths of the Danube navigable, has arrived at last in Constantinople. It is dated the 25th of August last, thus having for three months kept the European Commission in suspense. Meanwhile, the temporary works at the Sulina Mouth have been carried on with activity, the North Pier being extended 1,740 ft., and about £20,000 expended. These works, the Report condemns as a useless expenditure, the (Paris) Commission having adopted Captain Fowke's plan, viz., to open a canal, to be supplied with water from the sea, and closed by locks towards the river, thus shutting out the river-water and its deposits as much as possible. The canal to be opened to the north of the village of Kedrillis, in due easterly direction, so that its mouth towards the sea will be beyond the reach of the alluvial deposit of the St. George's Branch, or about 1,000 yards to the north of the present mouth of the river: its width sufficient for two vessels under sail to pass each other; that is, from 40 to 50 metres, with 5 metres depth under low-water mark; two sea-walls, or piers of *pierres perdues* to protect the mouth of the canal; the North Pier to be 150 metres longer than the South Pier, and to be carried out to a depth of 7 metres. Space between these two piers to be from 300 to 400 metres, in order to form an *avant port*, or harbour of refuge. At extremity of piers, lighthouses are to be constructed, and, if necessary, large lamps distributed along the canal, to facilitate the navigation at night. Estimated expense of works, 12,000,000 fr.; to meet which a tax of 3 fr. per ton is to be imposed on vessels navigating the canal. The temporary works at the Sulina to be discontinued.

In Boulogne Harbour a new quay or low-water landing-place [*quai de marée*], long wanted, is at last to be constructed. The commission appointed on the subject have unanimously approved of the plan submitted by the Government; and the engineer to whom the work is intrusted, hopes to commence operations next month.

Mersey Docks and Harbour.—The nomination of members for the new Board took place on the 1st January ult.

The Canadian Canals.—The Canadian Government has, up to this time, completed five canals, with a uniform depth of 10 ft., and locks 200 ft. by 45 ft. By their means, a vessel drawing 10 ft. can be taken from Fond du Lac, on Lake Superior, to the Gulf of St. Lawrence, a distance of nearly 2,200 miles. The aggregate tonnage entered, inwards and outwards, by the canals, and representing the trade on the inland waters in 1856, was:—American—steam, 1,434,779; sail, 464,822; British—steam, 397,587; sail, 174,619. Total—steam, 1,832,366; sail, 639,441; figures clearly indicating the importance of the canal interests.

The North Branch Canal affords complete water communication between Philadelphia and Canada.

The Welland Canal, connecting Lake Erie and Ontario, is reckoned one of the finest hydraulic works ever undertaken. Opened in Canada to compete with the Erie Canal (connecting Lake Erie with the Hudson River, and by which the Americans had contrived (1825) to divert the entire trade of the West to New York), its traffic has continued to increase year by year, until it has far outstripped that of its rival, the Erie Canal.

The Rideau Canal, which has its mouth at Kingston, unites Ontario, and, consequently, the St. Lawrence to Ottawa. In going down, the largest steamboats boldly shoot the rapids.

Altogether, the Canadian Canals overcome a total difference of height, from Lake Erie to the sea, of 564 ft. They have placed the inexhaustible resources of the West within the reach of the Montreal traders, being nearer to the Lakes, and carrying between them and tide-water cheaper and quicker than any other city in America.

MINES, METALLURGY, &c.

Gold Fields, Australia (from Melbourne).—Up to the 15th November ult., the total shipments of gold for the year 1858 have been 2,198,739 oz., which quantity brought into tons troy, gives 91 tons 12 cwt. 1 qr. 2 lbs. 6 oz., the value of which, at £4 per oz., amounts to £8,794,923. Up to same period of last year, the quantity shipped was 2,360,074 oz., or 98 tons 6 cwt. 9 qrs. 22 lbs. 20 oz.

A Piece of Gold, weighing 120 lbs., and worth £5,000, has been discovered within 50 miles of Bathurst.

A Fatal Colliery Accident, caused on this occasion, not by fire-damp, but by negligence with the machinery, has occurred at Pendlebury, near Manchester. Seven persons killed—viz., three men and four boys. [For details on inquest, *see* "Legal Decisions"—"Colliery Drums."]

The Port Phillip and Colonial Gold Mining Company held (12th January ult.) a long and stormy meeting, in the course of which a proposal to wind up was put and negatived. A dividend was declared of 1s. a share.

A Rich (Auriferous) Quartz Vein has (advices from California to the 10th December ult., received 16th January ult.) been discovered in the suburbs of San Francisco.

An Explosion of Fire-damp occurred, 19th January ult, at Low Hall Coal Pit (proprietors, the Moss Hall Company), near Wigan. Two men went down to repair at pump. A rush of air up the shaft knocked the "brow-man's" cap off: he called out "fire-damp." Some men descended, and found that the "fire-damp" had exploded, and killed the two men, one of whom was found near the pump; the other, a short distance off. The pit had not been worked for some time past, and it is supposed the foul air had accumulated, and had ignited at the naked light carried down by one of the unfortunate men.

Singular [Colliery] Escape.—On the night of the 14th December ult. a man employed at the Underwood colliery, in placing the trams on the top of the shaft, inadvertently put the tram on the wrong side, and was precipitated, in consequence, down the pit, a depth of 200 yards. Luckily, however, catching hold of the rope at the commencement of the descent, he slid down to the bottom without sustaining any harm, and coolly returned to his employment on the surface as though nothing particular had happened.

Open Colliery-Shafts.—Fatal Accident.—On the same day, during the dense fog, an aged watchman, employed at the colliery of Mr. Hartland, Hill Top, in South Staffordshire, was going his rounds, and was near to the mouth of one of his master's pits, when he failed to notice the open shaft, and fell into the pit, the shaft of which is of great depth. He was killed by the fall.

Of the "Coona" or Fitzroy River Goldfields (Northern Australia), somewhat conflicting accounts continue to be received. On the one hand, the fancied new Eldorado (a spot on the Fitzroy river, about 70 miles inland from the sea, and bearing the aboriginal name of Coona) is represented as being a mere dream, or mischievous delusion; whilst from other sources the yield, although inferior to the South Australian ore, is represented as promising.

Gold-dust [Australia] Sydney.—The quantity of gold-dust delivered by the escorts from the several (Australian) goldfields during the month of October, has been 22,037 ounces; against corresponding month of 1857, 15,189 ounces. Increase in receipts of the month, 6,848 ounces, or about 45 per cent. For the ten months of the year 1857, the receipts amounted to 117,493 ounces; during same period of 1851 the quantity received was 204,113 ounces; which is an increase of 86,620 ounces, or over 72 per cent. in favour of the present year.

Melbourne.—15th November ult. The escorts (of golddust) delivered into the gold-office of the Treasury this week, 48,361 ounces—a total above the weekly averages of the year, as also above that of the year 1857, which amounted to 47,670 ounces.

A Powerful "Beam Cornish" Pumping-Engine, the first of the kind ever erected in the State of Virginia (built by Messrs. Merrick and Sons, Southwark Foundry, Philadelphia, U. S.), has recently been erected for the Coal Mining Company, at their Mid-Lothian mines, in Chesterfield County, Virginia, 13 miles from Richmond, and half a mile from the Richmond and Danville Railroad. Cylinder, 60 in. in diameter, with 10 ft. stroke of piston. Piston packed with a single cast-iron ring, bored eccentrically, and slit and tongued on the thinnest side, being kept central and in contact by four springs. Beam 28½ ft. from centre to centre of end pins, having wrought-iron catch-pieces. Total weight of beam and centre shaft, 19 tons. Cylinder steam-jacketed and cased. Air-pump, 26 in. in diameter, 5 ft. stroke; vacuum attained, 28 in. Steam furnished by three single flue boilers, 6 ft. diameter and 26 ft. long, set below ground level. Boiler shells, or plates and flues, of ⅜ in. best Pennsylvania plates; the heads or ends of ½-in. plates. Chimney, 4 ft. square in the flue, and 70 ft. high. Engine erected on a vertical shaft, 770 ft. deep. Pit-work consists of three plungers and one drawing lift. Mainrod of Pennsylvania pine; the first 240 ft. from nose of the bob, 16 in. by 14 in.; the next 240 ft. is 14 in. square; remaining 240 ft. 12 in. square, making these rods 720 ft. long. It has four sets of catches, three of them on the down-stroke, and one on the up-stroke, which prevents the whole machinery travelling beyond a given length of stroke, in case of accident. This engine was started to work in May last, and in a few months drained the mines previously flooded by water coming in at the rate of 220,000 gallons in the 24 hours.

The Exports of Coal from Great Britain were, in 1857, 6,830,495 tons, being an increase on the preceding year of 942,898 tons. France, which in 1856 had received only 1,320,698 tons, received in 1857 from England 1,320,698 tons, exclusive of the contracts entered into by the French Government in London for the supply of fuel to the steam-vessels of the latter power at various points of the globe, especially in China.* Next to France, the chief consumers of English coal are the Hanseatic Towns, Denmark, Prussia, Spain, and Russia. As regards Turkey and the United States of America, the amount of exports to these hitherto considerable consumers of English coal, has, owing to political and commercial causes, greatly fallen off.

A Fatal Explosion (of Fire-damp) occurred recently at the Tunne Colliery pit, at Standish, near Wigan, by which two boys were killed. Caused by an escape of gas coming in contact with a naked light stuck against the wall by one of the pitmen.

A New Rope for Mines (patented) has been manufactured by Messrs. J. and E. Wright, of London and Birmingham. It is said to have been successfully tried by Mitcheson's Hydraulic Testing Machine, and to be in use at the London, East and West India, and Victoria Docks. Its advantages for mining purposes, particularly for long capstan ropes, there being a considerable saving in weight, are stated to be great. The invention consists in making a rope of hemp and wire combined, which gives even greater strength than wire-rope, with the pliability of the hemp rope. It is manufactured by placing a single wire inside every ropeyarn, securely coating each wire with hemp, and separating each hard substance, making a sort of cushion for each wire to bed upon; so that when any heavy strain is applied, the wires do not cut each other, as in all wire-rope. Compared with wire-rope, hemp-rope, and chain, each to take the same breaking strain, the new "patent wire and hemp rope" is stated to stand thus:—

Each to take breaking strain of 21 tons 0 cwts.; weight per fathom of patent wire and hemp, 10½ lbs.; ditto of wire-rope ungalvanised, 15¼ lbs.; ditto of hemp-rope, 21 lbs.; ditto of chain, 59 lbs.

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* The French "Tableau du Commerce" gives, for 1857, under this head, 1,299,855 tonnes métriques; of which quantity 1,055,616 entered into home (French) consumption.

Port Phillip and Colonial Gold Mines [Clunes].—The old squatting-station of Clunes is situated on the lower portion of Creswick Creek, about 20 miles north of Ballaarat. The Clunes quartz reefs are said to be the first ever worked in Victoria. Worked at first superficially, and without system, these mines, which are exceedingly rich, are now worked in a miner-like manner—indeed, on as perfect a system, by the application of capital and machinery, as that met with in the best-conducted mines of Europe. Temporary shafts have been sunk for working out the quartz above the water level, and tramways are laid in the levels, and from thence to the roasting-kilns. Another tramway is laid, on the surface, from the north shaft to the engine-shaft; and a double incline conducts the quartz from the engine-shaft to the crushing-works, the descending loaded waggons drawing up the empty ones. For working the veins below water-level, an engine-shaft has been sunk, between the "Old Man" and the east veins, to a depth of 250 ft., and a 30 H.P. engine erected, with 10 in. pumps, to draw off the water. At the foot of the hill are the crushing works, connected with the mine and the roasting-kiln by tramways leading to the hoppers. The crushing machinery consists of 44 heads of wet stamps, and one Chilian mill, the latter being, principally, used for testing small parcels. They will crush 400 tons of quartz per week to fine powder, the escapes being covered with a wire gauze having 256 meshes to the sq. in. A good supply of water is obtained from the Creswick Creek, which flows in front of the works.

Mining in Turkey.—The mines of the Pelion range are at present being worked by Englishmen with success, under a firman conceding the minerals of all Tricala and Janina for 21 years, terminating in 1887, for an annual payment of £600. The operations are principally confined to the dressing and smelting the rich ores of galena, yielding considerable quantities of silver and gold. Foremen, chiefly Englishmen, receive from £3 to £4 per week. Four hundred men and boys are employed at the Pelinn Works, and 20 tons of mixed metal are run every week, every ton of lead yielding from 60 to 160 oz. of silver and gold, the value of the gold being estimated as equal to that of the silver with which it is combined. The Turkish Government furnish a police force (from 25 to 50 men) especially for the protection of the miners against the attacks of pirates, to which, from their proximity to some of the Greek islands, they are constantly exposed.

Iron Works of Scotland.—During 1857 there were 123 blast furnaces in full work, producing 928,725 tons of iron, the highest figure hitherto attained in that (certainly, for its mineral products, most important) portion of the United Kingdom. In a single year it supplied, for national consumption and foreign export, 843,000 tons; and, notwithstanding this enormous supply, its stock in hand, on the 1st January, 1858, was 160,000 tons.

The Total Exports of Iron from Great Britain, according to the Board of Trade Returns, amounted, in 1857 (pig, bar, and steel), to 445,000 tons.

The Imports of English Iron into France increased, in 1857, by 4,545 tons, as regards pig iron, whilst, for bars, they decreased 41,825 tons.

To the United States the imports of English iron have slightly increased, as to castings and wrought, whilst, for bar, &c., there has been a decrease of 19,000 tons.

Bronze Casting.—A demi-bust and plate, cast in Russian gun-metal in the brass gun-foundry of the Royal Arsenal, Woolwich, representing the crowned head of Her Majesty, has been erected in the vacant space formerly occupied by the public clock, in the eastern ornamental archway of the Royal Artillery Barracks.

Australian [Sydney Royal] Mint.—From the 1st of January to the 5th of November, the amount of gold-dust imported into the Sydney Branch of the Royal Mint, for the purpose of coinage, has been 291,925 oz. During same period, the amount of coinage issued has been 891,500 sovereigns, and 486,000 half-sovereigns. Total value, £1,134,000.

Mineral Discoveries in Victoria.—The Bendigo papers announce the discovery of several mineral substances, which promise to be of great importance and value. The first resembles in colour and also in texture the red sulphuret of mercury, known in commerce as cinnabar. Of this mineral there are several varieties, as the opaque, having the hue of cochineal; the earthy, scarlet-tinted; the bituminous, slaty and brick-red; the chloride of mercury, found in small crystals, of a greenish-gray colour, embedded in ferruginous gangue, &c., with all of which characteristics of quicksilver ore, the Australian specimens alluded to are said to have points in common. Other considerations relating to these specimens lead, it would appear, to the probable opinion of the existence of coal, mercury, and bitumen in the midst of gold-fields—a combination of advantages which would indeed—to use the slightly sanguine, but, under the circumstances, excusable language of one of the local editors—"exalt Victoria to an eminence of prosperity such as the world has never seen."

APPLIED CHEMISTRY, &c.

Silicates of Potash and Soda.—New Process for fixing Crayon or "Pastel" Drawings.—M. Ortlieb has just communicated a paper to the Academy of Sciences on this subject. His plan consists in executing the pastel or chalk drawing upon thick but unsized paper, such as is used in copper-plate printing, and afterwards applying the fixing liquid (solution of silicate of potash or of soda) to the back, it is thus quickly absorbed, withaut causing any disturbance of colours on the other side. None but mineral colours should be used, these being the only ones that can combine with the silicates, which have no action on vegetable colours. The pictures thus treated will resist damp, or even washing with water; acid vapours have no effect on them, and they become almost incombustible.

Fatal Effects of Nitrous-Acid Gas.—A fatal accident occurred (3rd January ult.) at the Western Counties Superphosphate Manure Company's Works, Torpoint, Cornwall, in a lead tank, 100 ft. long by 17 ft. wide, and 12 in. to 13 in. deep, divided into three compartments, enclosed in a chamber lined with lead, about 15 ft high, three holes of 10 in. diameter in the roof for ventilation, and three man-holes in one side: this chamber is for the purpose of condensing the gas which arises from the sulphuric acid in the tanks. A leak having been discovered in one of the compartments, six men were directed to bale its contents into No. 2, an operation well known to be a highly dangerous one. The men began to complain successively of exhaustion, and were ordered by the manager to desist, and to go into the open air. Two of them, however, were past recovery, and died shortly after removal; the rest recovered. The inhalation of an over-quantity of the gas in the chamber is attended with dangerous consequences, because it contains an excess of oxygen—the very reverse of that which causes suffocation. Sulphuric-acid gas produces rapid pulsation, an excessive flow of blood through the lungs and heart, and a state of increased activity throughout the entire system.—[For inquest, *see* "Legal Decisions."]

Nitrate of Uranium [Coloured Photographic Manipulation]. — M. Niepce de St. Victor, amongst others of his recent discoveries tending to simplify the processes of photography, directs as follows:—Impregnate a sheet of paper with any soluble salt—say, for instance, with the nitrate of uranium;—let it dry in a darkened room, and then insolate it under a negative. Take it back into the dark room, and treat it with a solution of red prussiate of potash. A beautiful *red* picture will be obtained; and if this be afterwards treated with sulphate of iron, a fine *blue* picture will be produced, and if other re-agents be employed instead of the sulphate of iron, pictures of different colours may be obtained.

Electric Light.—A new process is spoken of as having been successfully tried; and, it is added, patented. Mercury, or other fluid or semi-fluid body, is used as one or more of the electrodes; a tube within the lamp is so arranged that it shall remain full, or nearly so, during waste or consumption by the light; the supply of the fluid electrode is regulated by a tap. Other improvements—such as the condensation of vapour on the lamp, by causing a constant flow of water over the glass, the prevention of vapours rising from the waste fluid, by the introduction of a stream of water into the waste-pipe, &c., &c.—are also mentioned; but a great step in advance will have been made, if only a constant, steady, unintermitting supply of light be effected by the apparatus in question. The use of mercury as an electrode is of ancient date,—coeval, we should think, with the earliest discoveries in galvanism itself.

Oxalate of Silver.—Xylo-Photography, or photography applied to engraving on wood.—A new method of printing photographic designs direct on to wood (other modes of attaining the same result have been for some time in actual practice) has been described in a recent number of the "Photographic News." The block is covered, in a darkened room, or by candlelight, with a mixture composed of oxalate of silver and water, to which may be added a little gum or pulverized bath-brick, to suit the convenience of the engraver. The oxalate is spread over the surface of the wood in precisely the same way as employed by wood-engravers in applying their mixture of flake-white and gum-water: about as much as would lie on a fourpenny-piece, for a block 4 in. square, is sprinkled on the surface; and the finger being then dipped in water, the mixture is spread evenly over the whole surface of the block, by rubbing the finger backwards and forwards across the block in various directions, until the evaporation or absorption of the water leaves the surface impregnated with a delicate and almost impalpable coating of oxalate of silver. The blocks so prepared may be left for any time (in a dark place) until required for use, as they will, if protected from the action of light, preserve their sensitiveness unimpaired. Oxalate of silver is susceptible of being acted upon by the actinic rays; and, therefore, if the block so prepared be exposed under a negative in the printing-frame to sunlight, a positive picture is obtained, in the same manner as on paper prepared in the ordinary way. The block requires no subsequent washing, nor any preparation of any description, before being placed in the hands of the engraver, who must not, however, expose it to the direct action of the solar rays while working on it, or it will gradually blacken on the surface; but diffused daylight has no deleterious effect upon it, unless such exposure be continued for a great length of time—say several hours.

Iodine a Specific for the Cure of Corns.—Recently, the outward application of the essential oil of chesnuts has been announced as a certain cure for the gout; and now, says the "Medical Times," Dr. Varges states that corns may be rapidly cured by the application of the tincture of iodine—the corn disappearing in a few days, if touched with the tincture several times a day; or, if the corn be situated between the toes, it should be covered with a piece of linen, steeped in a mixture of the tincture and glycerine.

ACCIDENTS FROM MACHINERY.

Feeding Machinery.—A labourer in the works of Messrs. Highland and Co., manufacturing chemists, Rose-street, Hutchesontown, whilst feeding the machinery with flour, got his arm entangled in some of the wheels, and was so injured by laceration as to necessitate his removal to the Royal Infirmary.

Railway Carriage Doors.—During a recent trip (on the 10th January ult.) from Dunse to Edinburgh, one of the railway-carriage doors had not been properly fastened; and, while the train was proceeding between Reston and Grant's House, a boy, 8 years of age, leaning against the door, fell out. It so happened that there was a small embankment where the accident occurred, and the youth, rolling into the ditch, luckily escaped without injury. The boy's mother attempted to jump out of the carriage after him, but was prevented. On the telegraph being put in motion, at Dunbar, she ascertained that her son was safe, and that he would be forwarded to Edinburgh by the next mail-train.

A Fatal Colliery Accident, caused on this occasion, not by fire-damp, but by negligence with the machinery for raising and lowering the men, has occurred (4th January ult.), at the Agecroft colliery-pit, Pendlebury, 4 miles from Manchester; 7 persons 3 men and 4 boys) killed.—[For details on inquest, *see* "Legal Decisions"—"Colliery Drums."]

Oiling a Treadmill.—Recently, the City Coroner held an inquest at Canterbury on the body of a prisoner in St. Augustine's Jail, who met with his death under peculiar circumstances, as detailed by the jail officials. In the treadmill there are two wheels. Deceased was oiling the machinery of the wheel not in motion. He was standing in the cylinder, with an oil-can in his hand: the lid of the can fell of, and rolled under the wheel in motion. Deceased got off the cylinder, and stooped down on his knees to pick up the lid, when he put his head between the spokes of the wheel in motion, and the upright standard supporting it; and his head was immediately crushed against the upright standard, and nearly severed from the body. Verdict, "accidental death," with a recommendation that in future both wheels should be stopped while the machinery was being oiled.

Self-acting Railway Points.—An accident took place (13th January ult.) at Bolton, in consequence of some self-acting points having failed to act in the proper manner. A passenger-train coming into the station was, consequently, turned off the line, and ran into a number of coal-waggons standing on the siding. Result:—destruction of the waggons, some injury to the engine, and bruises among the passengers. Fortunately, the driver had the presence of mind to reverse his engine before the concussion.

Screw-Steamer Collision in the Thames.—During the night of the 6th January ult., a collision took place between the *Lord Panmure* screw store-steamer and the *Derwent* screw-collier, a few miles below Sheerness. The *Lord Panmure* rapidly filled, and sank in twelve fathoms water. Crew saved. Loss estimated at several thousand pounds

Another Collision took place in Sea Reach, just above Chapman's light, between the *Great Northern* screw-steamer and the brig *Scadrift*, from the north, with coals. The latter was sunk in seven fathoms, and the *Great Northern* was so much damaged that she had to be run ashore on the Essex coast.

LIST OF NEW PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 15th September, 1858.

2154. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—The separation of iron and steel from their combination with certain foreign bodies.

Dated 11th October, 1858.

2258. J. Saxby, Brighton—Apparatus for working signals on railways.

Dated 22nd October, 1858.

2360. F. Whitehall, Bromley-place, Nottingham — Machinery for the manufacture of cap fronts.

Dated 1st November, 1858.

2428. F. Wrigley, Manchester—Self-acting safety coupling for railway and other purposes.

Dated 9th November, 1858.

2506. M. Henry, 84, Fleet-street—Manufacture of locks and fastenings, and keys for the same.

Dated 10th November, 1858.

2518. J. Corner, 15, Artillery-place, and 16, City-road, Finsbury-sq.—Machinery for making metallic screw rivets, and for uniting with them parts of boots, shoes, portmanteaus, and other leather articles.

Dated 13th November, 1858.

2548. J. Taylor, Birkenhead—Portable steam-engines.

Dated 16th November, 1858.

2572. A. I. H. Parent, Paris—An improved manufacture of buttons, and the apparatus employed therein.

Dated 17th November, 1858.

2588. M. Scott, 3, Stanhope-terrace, Hyde-park-gardens—Construction of breakwaters.

2586. E. Welch, 63, St. John's-square, Clerkenwell—Manufacture of tobacco, and apparatus therefore.

Dated 19th November, 1858.

2626. J. H. Johnson, 47, Lincoln's-inn-fields—Construction of electric telegraph cables or conductors.

Dated 20th November, 1858.

2638. W. Lea, Wolverhampton—Lubricating cocks & taps.

Dated 26th November, 1858.
2684. J. Harrison, Blackburn—Rollers applicable to sizing, dressing, calendering, and squeezing machines.
2686. A. Bowie, Glasgow—Governors for marine engines.
2688. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Manufacture of leather.
2690. T. B. Hubbell and G. J. Rollason, Castle-st.—Apparatus for brightening and polishing metal surfsces.
2692. W. Richards, Harpur-st., Red Lion-sq.—Construction of gas meters.

Dated 27th November, 1858.
2694. J. Spratt, 71, College-st., Camden-town—Manufacture and strengthening of paper.
2696. J. Ramsbottom, Accrington, Lancashire—Apparatus applicable to water meters, and to indicating and regulating the flow and pressure of fluids generally.
2698. R. Alexander, Dillichip, Dumbarton, N.B.—Treating, preparing, and bleaching textile fabrics and other materials.
2700. H. L. Pattinson, Stotes-hall, Jesmond, Newcastle-upon-Tyne—Utilizing tbe heat of slags of iron and other works.
2702. G. B. Sander, High Holborn—Jugs.
2074. S. Diggle, Radcliffe, Lancashire—Pattern chains, or other such apparatus used in weaving.

Dated 29th November, 1858.
2706. L. A. Possoz, Rue Neuve St. Augustin, No. 9, Paris—Manufacturing alkalies, and obtaining simultaneously other chemical products.
2710. G. Collier and W. Noble, Halifax—Means or apparatus for the manufacture of spokes for carriage wheels, wbich improvements are also applicable to the cutting of wood for other purposes.
2712. G. Hadfield, Carlisle — Construction of carboys, barrels and otber vessels of capacity.
2714. C. Hancock, West-st., Smithfield — Insulation and manufacture of electric telegraph wires and cables.
2716. W. A. Henry, Sheffield—Machinery or apparatus for attaching the soles and heels of boots to the upper-leathers, and in the fastenings employed for that purpose.
2718. J. B. Blanjot, 8, Rue Tbevenot, Paris—Petticoats for ladies.
2720. C. Bedells, Leicester—Manufacture of elastic fabrics, and machinery employed in this manufacture.
2722. G. J. Bensen, 7, Christian-street, St. George's-in-the-East—Cleansing or purifying animal charcoal after it has been employed by sugar refiners.

Dated 30th November, 1858.
2721. J. Luis, 1B, Welbeck-street, Cavendish-square — A watch, simplified with anchor escapements and rack, forming a double lever, catching in the pinion of its balance-wheel.
2726. A. A. Burton, 30, Wych-st., Strand—A moveable face and handle for smoothing-irons.
2728. D. Thomson, Old Brompton—Machinery for raising water and other liquids.
2730. A. E. C. Scbeidel, Watling-st.—Fastenings for belts, braces, pocket-books, and other similar articles or purposes.
2732. W. E. Newton, 66, Chancery-lane—Telegraphic apparatus.
2734. J. Coulson, Newark—Threshing and dressing-machines.

Dated 1st December, 1858.
2736. R. H. Bow, Edinburgh—Railway chairs and fastenings.
2738. E. Jones, Dudley—Manufacture of coke in ovens.
2742. J. Samuel, Great George-st., Westminster, and J. Nicholson, Wellington-st., Bromley— Connection with marine, and other steam engines.
2744. H. Adcock, City-road—Furnaces and apparatus for annealing wire.
2746. G. W. Bales, Ipswich—Apparatus for retaining doors when shut or closed.
2748. S. Newington, Ticehurst, Sussex—Agricultural implements.
2750. F. Fincham, Ravenhead, Lancashire—Construction of annealing kilns or ovens.
2752. J. Lewis, Elizabeth, U.S.—Means for attaching sails to tbe yards of ships or vessels.

Dated 2nd December, 1858.
2754. L. MacKirdy, Glebe Sugar-house, Greenock—Combined bathing, washing, and watercloset apparatus.
2755. L. MacKirdy, Glebe Sugar-house, Greenock — Manufacture of sugar.
2756. J. Rogers, 9, Queen-sq., Bsrtholomew-close—Manufacture of ropes, cables, cords, and lines.
2757. W. Robertson and J. G. Orchar, Dundee—Machinery for winding yarns or thread.
2758. J. Tyssen, Rotterdam, Holland—Obtaining and applying motive power.
2759. J. Baillie, Vienna, Austria—Construction of railway wheels.
2760. Lieut.-Col. G. Spiller, R.A., 15, Upper Southwick-st.—Knapsacks for military and other purposes.

Dated 3rd December, 1858.
2761. M. Henry, 84, Fleet-st.—Manufacturing or revivifying bone black or animal charcoal, and in kilns or apparatus employed therein.
2762. T. Bailey, 17, Russell-street, Birmingham—A mechanical movement applicable to loading fire-arms.
2763. M. Tooke, Norwich—Apparatus for measuring the human figure, and in applying the same for tracing out garments for the human figure.
2764. G. E. Noone, 28, Hodson-street, Frances-street, Newington-butts—Machinery for generating gas from coal.
2765. S. Peters, 12, Rue de la Briche, at St. Denis, near Paris—Manufacture of pipes and tubes, and in the apparatus employed therein.
2767. C. Coates, Sunnyside, near Rawtenstall, Lancashire—Maundrills for printing.
2768. C. F. Vasserot, 45, Essex-street, Strand—Apparatus for ventilating mines or other similar purposes.
2769. C. F. Vasserot, 45, Essex-st., Strand—Improved window sashes to prevent draughts and the infiltration of water.
2770. H. Bevan, Shrewsbury—Improved machines for facilitating arithmetical operations.

Dated 4th December, 1858.
2771. J. Cameron, Glasgow—Apparatus for the manufacture of sugar.
2772. R. Legg, 11, Ashby-street, Clerkenwell—A machine for combining the operation of compressing and cutting tobacco during the process of manufacture.
2773. L. W. Fletcher, Bleaklow, near Bury, Lancashire—Construction of electric telegraph cables.
2774. J. B. Fisher and J. Fisher, Stourbridge, Worcestershire, and J. Bird, jun., Kingswinford, Staffordshire—Doors and dampers of furnaces.
2775. R. Pickering, Lockerbie, Dumfries—Communicating signals from one part of a railway train to another.
2776. E. A. Servier, Paris—Pressure and fluid level indicators.
2777. T. Sibley, Ashton-under-Lyne—Looms for weaving.
2778. A. Smith, J. Townsend, and E. W. Williams, Birmingham—Breech-loading fire-arms.
2779. J. B. A. Monnier, Nemours (Seine et Marne), France—Actuating railway brakes.
2780. J. Turner, 8, Lavender-grove, Queen's-road, Dalston—Chairs.
2781. H. T. Yates, Hounds-gate, Nottingham—Manufacture of boards or sheets when wood sawdust is used.
2782. J. L. Norton, Belle Sauvage-yard, Ludgate-hill—Machines for stretching and drying fabrics, and in drying wool and other fibres.
2783. M. Henry, 84, Fleet-st.—Weaving, and in looms, or apparatus employed therein.
2784. W. E. Newton, 66, Chancery-lane—Grain and grass harvesting machines.
2785. J. Platt, Oldham—Mules for spinning.
2786. T. R. Harding, Leeds—Combs, gills, hackles, and similar implements used in silk, wool, and flax macbinery.

Dated 6th December, 1858.
2787. J. Jobson, Derwent Foundry, Derby—Manufacture of stoves and fireplaces.
2788. J. G. Arnold, Worcester, Massachusetts, U.S.—Envelopes for letters and similar purposes.
2789. B. Nicoll, 40 and 42, Regent-st.—Agricultural machinery for all kinds of crop and other root-cutting, and for the purposes of haymaking, and rubbing corn and seed from the stalks (instead of threshing).
2790. J. Muir, Glasgow, and F. Muir, Paisley—Ornamental or color printing.
2791. G. Snell, Leeds—Machinery or apparatus for cutting woollen fabrics.
2792. J. Dawson, Holbeck, Leeds—Apparatus for raising the nap on woollen cloths.
2793. D. B. White, Newcastle-upon-Tyne — Indicating gauges.
2794. R. A. Brooman, 166, Fleet-street—Manufacture of gloves.
2795. F. W. Fletcher, Hurdington, near Birmingham—Bolts for securing doors, and other purposes.
2796. E. W. Scale, Merthyr Tydvil, Glamorganshire—Railway and other breaks.

Dated 7th December, 1858.
2797. J. E. Boyd, Hither Green, Lewisham—Construction of taps, valves, or other apparatus for gauging or for drawing off the liquid or fluid contents of any cask, or other vessels.
2798. W. A. Gilbee, 4, South-street, Finsbury—An improved portable bath.
2799. C. Williams and W. Ellison, 17, Acton-place, Kingsland-road—A new mode or method of securing and liberating the corks and stoppers of bottles.
2800. J. Whiteley and T. Kitchenman, Halifax—Press-plates or apparatus employed in hot-pressing woven fabrics.
2801. W. Madders and J. Waddington, Manchester—Machinery or apparatus for embroidering woven fabrics.
2802. J. J. Harris, Woodlesford, near Leeds—Apparatus for refrigerating and regulating the temperature in worts and beer.
2803. G. E. Larned, Brooklyn, U.S. — Construction and arrangement of boilers and working parts of steam fire-engines, part of which is applicable to engines for other purposes.
2804. J. V. Scarborough, Belfast, Ireland—Manufacture of boots and shoes.
2805. J. Haslam and J. Lutener, Preston—Healds used in looms and dressing-frames.
2806. W. Burness, 2, Prospect-terrace, Brixton—Pumping and forcing liquids.
2807. S. W. Pugh, Nelson-sq., Commercial-rd., New Peckham—Obtaining and purifying naphtha, paraffine, and other oils, and also spirits.
2808. J. Ferrabee, Phœnix Iron Works, and F. H. England, Foomhall mills, Stroud — Machinery for carding, scribbling, and condensing wool.

Dated 8th December, 1858.
2810. G. F. Chantrell, Liverpool—Apparatus applicable to the manufacture and revivification of animal or vegetable charcoal.
2811. C. de Cappot and A. Jarriant, 10, Route de la Révolte, Neuilly-sur-Seine—A new hydrsulic counter.
2812. R. L. P. Manning, Princes-square, Middlesex — A floating paddle-wheel.
2813. M. Henry, 84, Fleet-street— Twisting fibrous materials.
2814. S. Phillips, Mnseley, near Birmingham—Sliding window sashes, shutters, and doors.
2815. A. Lamb and W. A. Summers, Southampton—Apparatus for superheating steam.
2816. W. King, jun., Guildford — Apparatus for roasting coffee and other substances.
2817. C. M. Westmacott, Arboretum-street, Litchurch, near Derby—Permanent way of railways.
2818. H. Meidinger, University of Heidelberg, Germany—Electric batteries.

Dated 9th December, 1858.
2819. R. L. Burrowes and J. Knowles, jun., St. Helen's—Construction of pianofortes and organs.
2820. J. Barrow, jun., Manchester—Treatment of coal gas tar, and of the oils obtained by the distillation of the same.
2821. H. Maudsley, 4, Cheltenham-place, Lambeth—Glass and other vitreous vessels.
2822. J. Eccles, Blackburn—Machinery for manufacturing clay and other plastic earths into bricks, tiles, and pipes.
2823. H. Bell, Belfast, Ireland—Musical instruments.
2824. J. Little, Glasgow—Fire grates and heating apparatus.
2825. J. Elder, Glasgow—Paddle-wheels.
2826. J. Stewart, 69, Tottenbam-court-road—Construction of the action of pianofortes.
2827. T. Allen, Clifton, Bristol—Folding bedsteads.
2828. J. Wilson, Wansford, Northamptonshire—Machinery for tilling and cultivating land.
2829. H. Wilson, Norton, Durham—Pumps.
2830. E. L. Pensuete, Dunkirk, France — Apparatus for driving piles by steam.
2831. B. Lautb, Morley's Hotel, Trafslgar-square—Mode of manufacturing rods and shafts.

Dated 10th December, 1858.
2833. J. Lightfoot, Accrington, Lancashire — Printing or staining yarns, fabrics, or fibrous substances.
2834. J. Flockton, jun., Manchester — Stop or reversing taps.
2835. A. Barclay, Kilmarnock, N.B.—Electric, magnetic, and electro-magnetic telegraph ropes or conductors.
2836. A. Barclay, Kilmarnock, N.B. — Obtaining motive power by means of electricity, magnetism, and electro-magnetism.
2837. C. Hodgson, Ballard Rathdrum, Wicklow, Ireland—Fuel from peat.
2838. W. Beardmore, Deptford—Steam boilers.
2839. G. F. Wilson, Belmont, Vauxhall—Manufacture of lubricating oils.
2840. G. W. B. Kiallmark, Bridgewater, and W. T. Timewell, North Wharf-road, Paddington—Manufacture of cements.

Dated 11th December, 1858.
2841. W. F. Hall and T. Dutson, St. Paul's-squsre, Birmingham—Fancy buttons for ladies' and gentlemen's wear.
2842. J. B. Guthrie, Manchester—Manufacture of india-rubber overshoes.
2843. S. Dudgeon, Sheffield—Gas regulator.
2844. J. Hinks, Birmingham—Ships' and other lamps.
2845. P. Robertson, Sun-court, Cornhill—Shuttles.
2846. C. J. Richardson, 34, Kensington-square—Apparatus to be applied to chimneys or flues of buildings, for economizing heat.
2847. M. Schaffner, Eisenach—Smelting zinc ores, and in furnaces employed for this purpose.
2848. W. E. Wiley, 34, Great Hampton-street, Birmingham—Ever-pointed pencils.
2849. A. Rollason, Birmingham — Manufacture of waterproof tissues.

Dated 13th December, 1858.
2850. J. A. Carruthers and T. Blackburn, Blackburn, Lancashire—Apparatus for guiding and regulating the warp threads in the operations of warping, tape-sizing, looming and weaving.
2851. R. Whittam, Accrington — Apparatus for tracing designs from an engraved roller, or from an engraver's sketch upon steel or other metallic surfaces.
2852. L. C. V. Yon, Lisieux, France—Elastic beds.
2853. J. M. Roussel, 8, Impasse des Couronnes, Belleville, near Paris—Apparatus using air as a motive power.
2854. J. E. Boyd, Hither-green, Lewisham—Candlesticks, lamps, and lanterns.
2855. R. A. Brooman, 166, Fleet-street — Twisting and otherwise operating upon threads, twine, or cords.
2856. R. A. Brooman, 166, Fleet-street—Manufacture of cranked axles and shafts.
2857. E. Loomes, Whittlesea, Cambridgshire — Steam engines.
2858. J. Ferrabee, Phœnix Iron Works, Stroud — Steam engines.

Dated 14th December, 1858.
2859. J. Webster, Birmingham — Recovering copper and zinc from liquids which have been employed to dip

or pickle articles made of brass or other alloys containing copper and zinc.
2860. E. Bow, Port Dundas, Lanark, N.B.—Pumps.
2861. D. Anderson, Glasgow—Taps or valves.
2862. J. Wade, Bradford—Apparatus employed in weaving.
2863. G. W. Baker, Park Farm, Woburn, Bedfordshire—Construction of manger fastening.
2864. R. A. Brooman, 166, Fleet-street—Transmitting electric telegraph signals.
2865. J. T. Smets, Plagamen, France—Making vinegar from a refuse product obtained in the manufacture of starch.
2866. F. Jossa, Bishop Auckland, Durham—Furnaces for generating steam and other purposes.

Dated 15th December, 1858.

2867. J. Pendlebury, Crumpsall, Lancashire—Apparatus for bleaching or cleansing textile fabrics or materials.
2868. D. Rowan, Greenock—Steam engines.
2869. H. Bridges, Bridgwater—Means of working breaks on carriages on railways.
2870. F. C. N. J. V. Migeon, Morvillars, France—Manufacturing screws, nails, spikes, and all similar articles made of metallic wire.
2871. A. V. Newton, 66, Chancery-lane—Machinery for manufacturing bullets.
2872. A. V. Newton, 66, Chancery-lane—Arrangement of condensing apparatus.
2873. J. Bullough, Blackburn—Looms.
2874. C. F. Vasserot, 45, Essex-street, Strand—Pendulum governor for regulating the supply of steam to the cylinders of marine engines.
2875. W. Clark, 53, Chancery-lane—Agricultural implements.
2876. J. Wardill, Commercial-road-east—Controller, to stop and control the running out of chains and ropes.
2877. G. Bell, Wandsworth—Matches and fusees.
2878. T. Moss, Gainsford-street, Islington—Printing banknotes, bills of exchange, and other documents requiring like security against being copied.
2879. W. Morgan, Witton Park Iron Works, near Darlington, Durham—Manufacture of iron.

Dated 16th December, 1858.

2881. W. H. Carmont, 2, Rosamond-place, Upper Brook-street, and W. Corbett, 22, Blantyre-street, Chester-road, Manchester—Constructing furnaces for the production of wrought iron and steel.
2882. A. Stokes and F. J. Stokes, Birmingham—Manufacture of screws.
2883. R. Mushet, Coleford, Gloucestershire—Improved manufacture of cast steel.
2884. Capt. J. H. Selwyn, R.N., Woodland-crag, Grasmere, Westmoreland—Apparatus for paying out submarine telegraph cables or wires, and for raising the same after they have been laid down.
2885. J. W. Edge, Manchester—Balls, bullets, or other projectiles to be employed in fire-arms or ordnance.
2886. J. W. Friend, Freemantle, Southampton—Apparatus for ascertaining and registering the depth and flow of liquids.
2887. A. Mackenzie, Glasgow—Sewing machines.
2888. J. J. Margais, Paris—Galvanic batteries.
2889. W. White and J. Parlby, Great Marylebone-street—Treatment of "carton pierre," and such like composition.
2890. R. A. Brooman, 166, Fleet-street—Plating and gilding forks, spoons, and other metal articles.
2891. W. Clark, 53, Chancery-lane—Submarine electric telegraph cables or conductors.

Dated 17th December, 1858.

2892. J. J. Aston, 41, Doughty-street, Middlesex—Propulsion of ships' boats and other vessels on and through the water.
2893. W. B. Johnson, Manchester—Apparatus for preparing for joining the rails of railways.
2894. J. Inshaw and J. Inshaw, Birmingham—Locomotive engines.
2895. A. Hinde, Wolverhampton—Preparing the cinder or slag from puddling furnaces for the purpose of facilitating the manufacture of iron therefrom.
2896. J. Kerr, 17, Bedford-terrace, Trinity-square, Southwark—Revolving fire-arms.
2897. J. Clegg, Keighley, Yorkshire—Lubricating the valves and pistons of steam engines.

Dated 18th December, 1858.

2899. J. Aitken and J. Brooks, Irwell Vale Mill, Edenfield, near Bury—Looms.
2900. J. MacKenzie, St. Martin's-le-Grand—Ventilating sun burners.
2901. A. Mitchell, Glasgow—Apparatus for registering the speed of engines and other machinery.
2902. J. Taylor, Birkenhead—Pumps or engines for lifting and discharging water.
2903. A. P. How, Mark-lane—Cocks or stop valves.
2904. E. Weber, Mulhouse, France—Dyeing textile fabrics and materials.
2905. J. Soutter, Edinburgh—Apparatus for drying or airing linen or other articles of wearing apparel.
2906. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for re-working the waste steam of steam-engines.

Dated 20th December, 1858.

2907. T. S. Woodcock, Salford—An improved index or book and paper marker.
2908. S. Hunter, Newcastle-upon-Tyne—Construction of Anchors.
2909. R. Maclehose, Ayr, N.B.—Stereoscopes.
2910. J. Ronald, Liverpool—Machine for the direct spinning of hemp and other fibrous materials.
2911. A. V. Newton, Chancery-lane—Lanterns.

Dated 21st December, 1858.

2912. F. Winter, Hoxton—Application of varnishes for waterproofing paper, linen, and textile fabrics.
2913. R. McLean, Livingston, Alabama, U.S.—Self-detaching "safety-hook" or coupling.
2914. W. E. Dando, Manchester—Apparatus for lowering boats from ships or vessels.
2915. J. H. Bolton and C. Garforth, Chester—Drying yarns or fabrics.
2917. W. S. Yates, Leeds—Apparatus for dragging bristles and drawing air and vegetable fibre.
2918. N. Dawson, 76, High-st., Poplar—Order books.
2919. W. Mainwaring, Brunfield, Herefordshire—Brakes for common road vehicles.

Dated 22nd December, 1858.

2921. R. Mushet, Coleford, Gloucestershire—Manufacture of cast steel.
2922. G. Sharp and W. Elder, Jarrow, Durham—Furnaces and steam-boilers.
2923. J. Nicholson, Halifax, and D. Crossley, Brighouse, Yorkshire—Jacquard machinery employed in weaving.
2925. W. Spence, 50, Chancery-lane—Granaries for preserving grain.
2926. E. T. Dunn, Hammersmith—Fabrics suitable for the covering of floors, walls, and other like purposes.
2927. E. Green, Wakefield—Tables.
2928. M. Shuldham, Dursley, Gloucestershire—Ships and vessels, and working parts of their gear and rigging.
2929. E. Ransome, Ipswich—Manufacture of grinding and rubbing surfaces.
2930. A. Prince, 4, Trafalgar-sq., Charing-cross—Ornamenting and illuminating surfaces of glass.
2931. J. J. Welch, 17, Cheapside—Manufacture of neckties, scarfs, or cravats.

Dated 23rd December, 1858.

2932. D. Lichtenstadt, Henry-cottages, Park-road, Peckham—Converting a certain vegetable substance into fibrous material.
2933. J. Ronald, Liverpool—Machinery for the manufacture of "hard-tapped" and "soft-laid" twine, and cordage generally from heap, and other like fibrous material.
2934. T. Bird, Manchester—Manufacture of cop bottoms or cop tubes.
2935. J. Broom, Glasgow—Manufacture of steel.
2936. J. Whitelaw, Dunfermline, Fife, N.B.—Sewerage and drainage apparatus.
2937. A. Barclay, Kilmarnock, N.B.—Obtaining and distributing or applying electricity and magnetism.
2938. J. Maudslay, Lambeth—Construction of ordnance, and projectiles to be used therewith.

Dated 24th December, 1858.

2939. J. T. P. Newbon and T. Smith, Fenchurch-street, and J. Brown, Follit-street—Apparatus for raising and lowering or otherwise moving heavy weights.
2941. J. W. Child, Halifax—Manufacture of fabrics adapted to be used for curtains, coverings of furniture, table covers, and such like uses.
2942. J. W. Child, Halifax—Dyeing wool and other fibres.
2943. L. D. Owen, 192, Tottenham-court-road—Manufacturing horse-shoe nails.
2944. E. Fellows, Canterbury—Vent-peg.
2945. D. Edleston, Halifax—Preparing and finishing textile fabrics.
2946. J. Railton and S. Lang, Blackburn—Looms.
2947. E. Humphrys, Deptford—Brazing metal tubes in tube plates and other metal surfaces to each other.
2948. A. Smith, Humbleton-hall, Yorkshire—Gigs, dog-carts, and other vehicles.
2949. J. Little, Glasgow—Lamps.
2950. J. H. Johnson, 47, Lincoln's-inn-fields—Permanent way of railways.
2951. R. L. Giandonati, St. Paul's-churchyard—Ornamenting leather-cloth.
2952. W. B. Johnson, Manchester—Employment of gas for generating steam, and in engines connected therewith.

Dated 27th December, 1858.

2955. T. Steven and T. Scott, Glasgow—Heating apparatus for culinary and warming purposes.
2956. J. Smethurst, Guide-bridge, Lancashire—Metallic pistons.
2958. W. A. Gilbee, 4, South-street, Finsbury—Treating fatty bodies.
2959. J. Macpherson, Aberdeen—Solidifying the raspings and other waste of horns and hoofs.
2961. C. M. Marion, Paris—Case for containing and preserving sensitive photographic paper, called "Marion's box."
2963. H. Lowe, W. Trueman, and J. L. Pitts, Birmingham—Improved axle for carriages.
2964. R. Hornsby, jun., Grantham, Lincolnshire—Ploughing and tilling land by steam-power.

Dated 28th December, 1858.

2965. B. Browne, 52, King William-street, London-bridge—Manufacture of boots and shoes.
2966. J. Sinclair, Dublin—Pistons.
2967. T. Warren, Glasgow—Manufacture of glass bottles.
2969. J. Leck, Glasgow—Drying textile fabrics and materials.
2970. C. Fay, Manchester—Railway carriages and brakes.
2971. J. H. Johnson, 47, Lincoln's-inn-fields—Manufacture of boots and shoes.

Dated 29th December, 1858.

2972. W. Haworth and W. Baker, Todmorden, Yorkshire—Top clearers of machines for spinning.
2973. T. Welton, 29, New Compton-street, Soho—Giving or obtaining publicity.
2974. E. W. Carter and J. D. Abrams, Rochdale—Sewing machines.
2975. W. Taylor, Nursling, and W. D. Grimshaw, Southampton—Regulating the admission of natural atmospheric air and eduction of rarefied air or gases from outhouses or any other place or premises, and for supporting a required temperature.
2976. R. D. Kay, Accrington, Lancashire—Applying or fixing on woven or felted fabrics certain colouring matters produced from tar.
2977. T. Pickford, 15, Mark-lane—Manufacture of manure.
2978. H. Hutchinson, Paris—Manufacture of india-rubber goods.
2979. S. Morand, Manchester—Apparatus for stretching fabrics.
2980. A. V. Newton, 66, Chancery-lane—Machinery for reaping and mowing.
2981. T. W. Gowing, Camden-town—Roughing for the shoes of horses.

Dated 30th December, 1858.

2982. H. N. Maynard, Crumlin, Monmouthshire—Anchors.
2983. F. Puls, Roxburgh-terrace, Haverstock-hill—Treatment of hydro-carbons.
2985. F. Johnson and J. H. G. Wells, 12, North-st., Westminster—Breakwaters and other similar structures.
2986. J. F. C. Heyne, Antwerp—Railway chairs and rails, and in the mode of fixing the same.
2987. T. Bell, Plaistow, Essex—Purifying gas.
2988. R. A. Brooman, 166, Fleet-st.—Stoppering or closing bottles, jars, and other like vessels.
2989. R. A. Brooman, 166, Fleet-st.—Washing and drying machinery.
2990. R. A. Brooman, 166, Fleet-st.—Revolving fire-arms.
2991. R. A. Brooman, 166, Fleet-st.—Machines for embroidering.
2992. R. A. Brooman, 166, Fleet-st.—Machinery for splitting or dividing hides, skins, leather, and other like materials.
2993. R. A. Brooman, 166, Fleet-st.—Pipes for smoking.
2994. W. Burgess, Newgate-st.—Apparatuses for converting reciprocating into rotary motion.
2995. S. S. Bateson, 17, Bolton-st., Mayfair—Generating steam.
2996. J. Knowelden, Southwark, and R. D. Edwards, Upper Belgrave-place—Hydraulic engines.
2997. J. W. Duncan, Grove-end-rd., St. John's-wood.—Appliances for transmitting or conducting signals or action by electricity or magnetism.

Dated 31st December, 1858.

2998. J. H. Johnson, 47, Lincoln's-inn-fields—Permanent way of railways.
3000. H. Robin, Nantes, France—Reaping machines.
3002. T. Z. L. Maurel, 44, Rue du Dragon, Paris.—Protracting indefinitely the working of any mechanism set in motion by springs, more generally applicable to clockmaking.
3006. L. A. Normandy, 67, Judd-st.—Shaft tugs.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2953. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Composition for the protection of certain metallic surfaces.—27th December, 1858.
2957. J. Shaw, Manchester—Mechanical combination, called an indefinite feed movement.—27th December, 1858.
26. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Steam generators.—3rd January, 1859.
78. T. H. Toms, Staining-lane—Materials for the production of raised ornamental figures or devices upon textile fabrics.—10th January, 1859.

DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

4132.	Nov. 16.	B. Edgington, 2, Duke-st., Southwark, "Base and Tripod for supporting the Centre Pole of a Tent."
4133.	„ 22.	Smith and Ashby, Stamford, "Feed Roller for Chaff Cutter."
4134.	„ 30.	A. Perry, 26, Ann-street, Birmingham, "Hall's Patent Cartridge Carrier."
4135.	„ 30.	W. Aston, Princip-street Works, Birmingham, "The Improved Alliance Buckle."
4136.	„ 30.	F. B. Anderson, 56, High-st. Gravesend, "Spectacle Side-piece Fastener."
4137.	Dec. 1.	W. Hewitt, Birmingham, "Rein Holder."
4138.	„ 7.	A. Singer, Vauxhall Pottery, Vauxhall, Lambeth, "Cap or Cover for a Jar."
4139.	„ 9.	E. Wilks, Hanover House, Cheltenham, "Gentlemen's Wardrobe Hatcase Portmanteau."
4140	„ 13.	Panklibanon Furnishing Ironmongery Co. (limited), 56, Baker-st., "The Standing Safety Fireguard."
4141.	„ 15.	S. Collins, Birmingham, "Rack Pulley."
4142.	„ 20.	G. A. B. Chick, Milk-st., Leek-lane, and Callow Hill-st., Bristol, "A Block of Black Lead."
4143.	Dec. 27.	J. H. Powell, 121, Newgate-street, E.C.—"Portable Stereoscopic Camera."
4144.	„ 28.	T. Cowburn, Manchester—"Steam Pumping Engine."

ENGINES OF SCREW STEAM SHIP

"ARTIZAN,"

Constructed by MESSRS STOTHERT & MARTEN, Bristol.

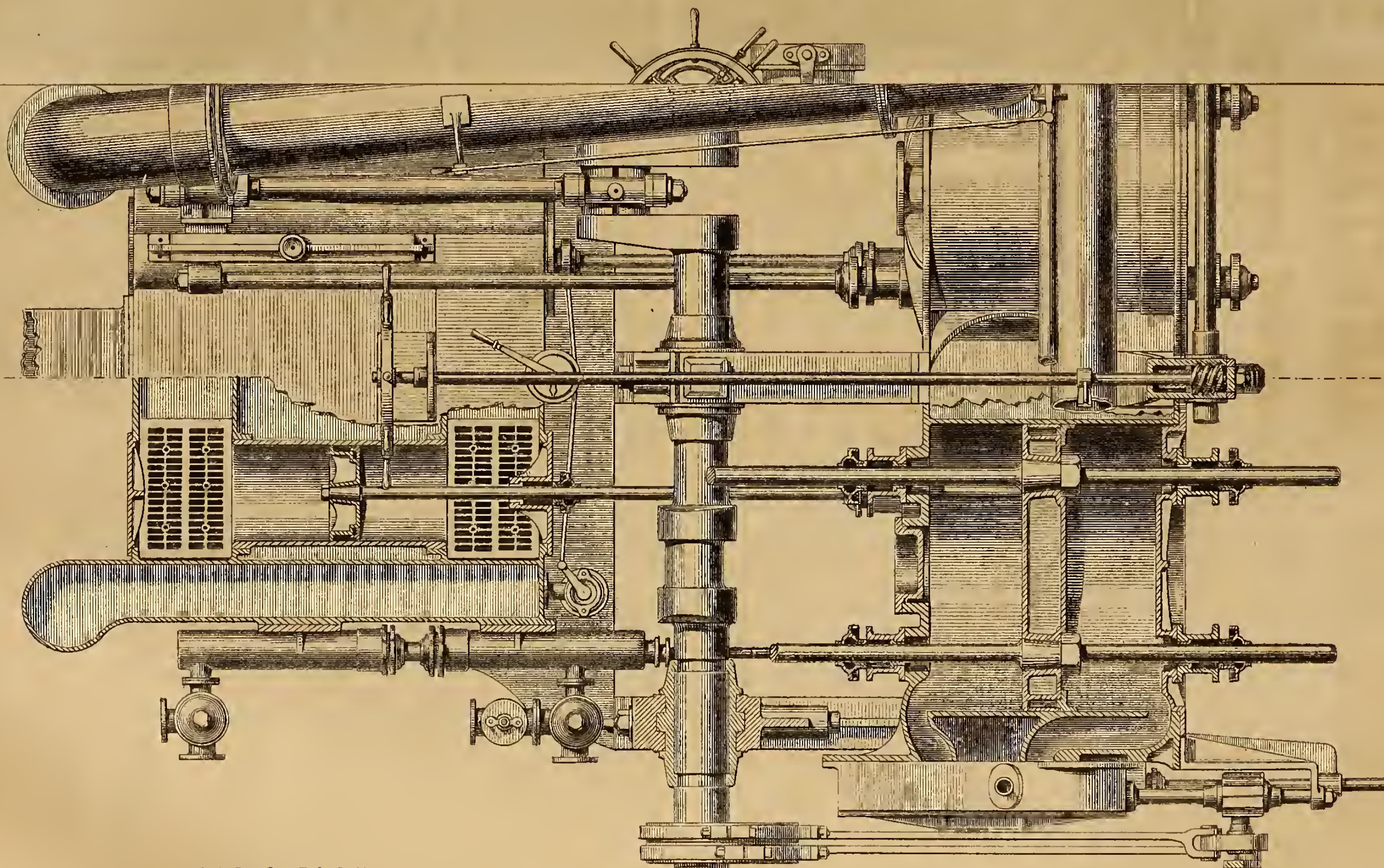


FIG. 3. PLAN.

W. Smith, C.E. delin.

ENGINES OF SCREW STEAM SHIP "ARTIZAN,"

Constructed by MESS^rs STOTHERT & MARTEN, Bristol.

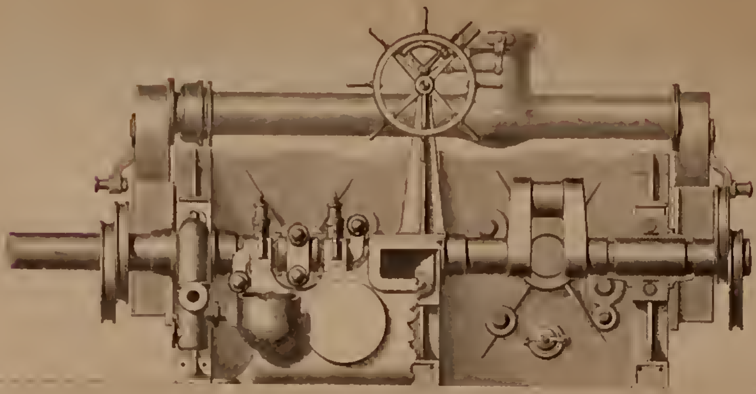


FIG. 1. END ELEVATION

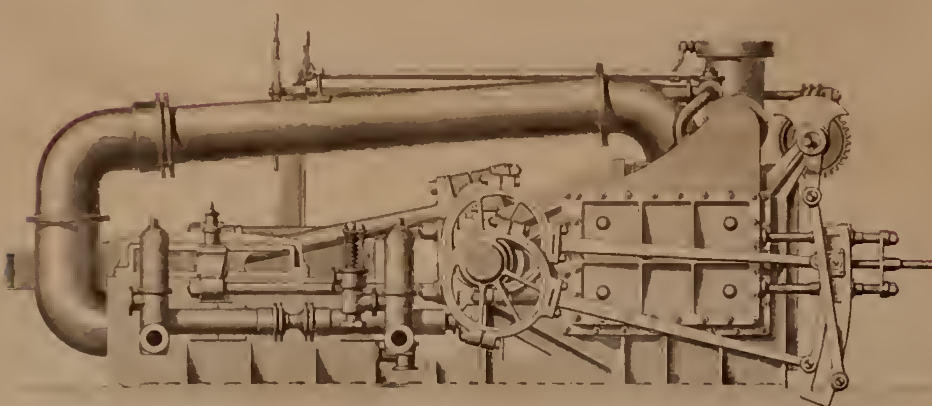


FIG. 2. SIDE ELEVATION.

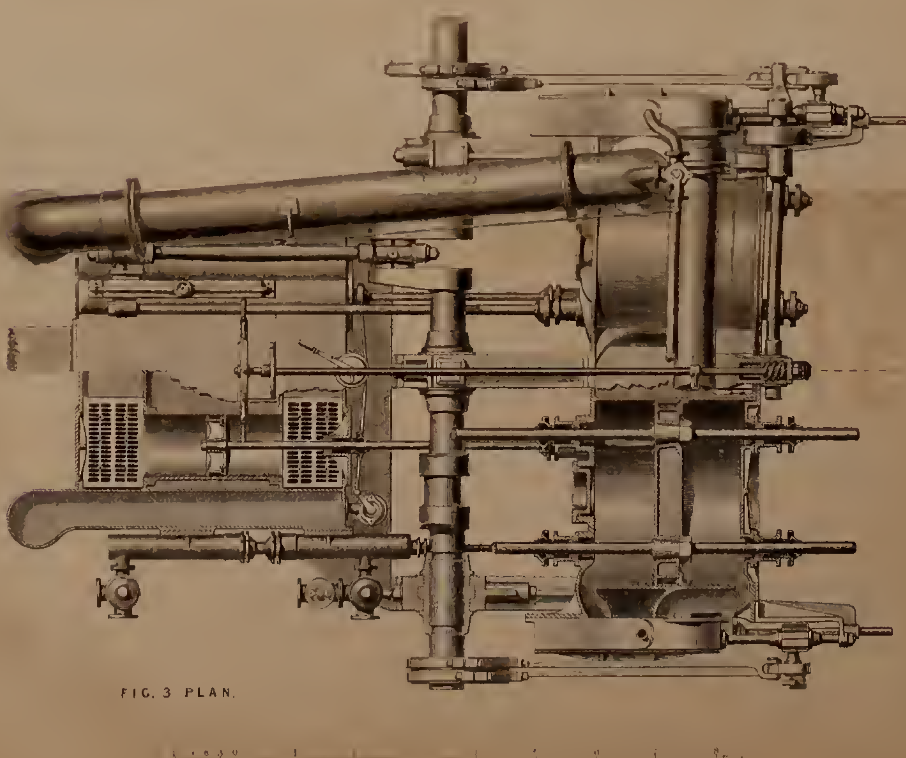


FIG. 3 PLAN.

Feet

VESSEI: Tonnage.	VESSEI: Speed per hour.	RATIO OF: Vessel's length to breadth.	RATIO OF: Screw's pitch to diameter.	RATIO OF: Midship section to screw's disc.	RATIO OF: Nominal power to Midship Section.	RATIO OF: Nominal power to (Displacement) $^{2/3}$.	RATIO OF: Indicated power to Midship Section.	RATIO OF: Indicated power to Displacement.	The Area of the Midship Section: (Speed) ^{3} × Midship section / Nominal power.	The Area of the Midship Section: (Speed) ^{3} × Midship section / Indicated power.	Displacement: (Speed) ^{3} × (Displacement) / Nominal power.	Displacement: (Speed) ^{3} × (Displacement) / Indicated power	REMARKS.
	Knots.												
1761	6·458	·625	1·25	3·73	0·60	2·25	1·17	4·39	448·8	229·8	119·6	61·3	Not rigged, but ballasted.
,,	7·147	,,	1·12	4·01	0·56	2·12	1·05	3·98	645·7	348·2	172·1	91·5	Ditto ditto.
1474	6·75	4·1	1·4	3·09	0·55	1·87	1·08	3·69	559·7	283·5	164·	83·1	Rigged and fully equipped for sea.
970		5·32											Engines appropriated to Horatio not completed.
,,	7·818	,,	0·86	5·84	0·54	1·73	0·93	2·99	888·8	515·3	275·4	159·7	With Rifleman's Engines; not rigged, but ballasted.
1872	8·295	4·37	0·96	3·07	0·62	1·98	1·07	3·43	919·5	531·1	287·6	161·1	Rigged and fully equipped for sea.
43	6·822	5·17	1·21	3·76	0·35	0·97			895·3		327·9		Fitted with paddle-wheels also, speed 7·501 knots.
1832	5·816	3·73	1·25	3·67	0·61	2·27	1·27	4·73	322·6	154·7	86·6	41·5	Rigged and partially equipped.
1074		5·53											Not completed.
1038	9·289	5·6	1·22	2·81	0·99	3·13	1·93	6·08	805·5	414·5	225·8	131·6	Rigged and partially equipped.
													Not eompleted.
1497	7·366	5·28	1·22	3·09	1·11	3·38	1·55	4·73	359·9	257·4	117·9	84·4	Jury rigged, ballasted to trim.
1569	10·293	5·48	,,	,,	,,	3·37	2·33	7·09	982	467·6	322·9	153·8	Rigged and fully equipped subsequent to alteration of stern
1037	9·432	5·6	1·08	2·95	1·02	3·19	1·78	5·57	822·3	470·3	263·1	150·5	
164	10·537	7·87	1·41	1·74	2·04	4·23	4·91	10·16	571·9	238·3	276·3	115·1	Not rigged.
													Engines not appropriated.
953	10·254	5·73	1·25	2·81	1·13	3·2	2·11	5·98	952·3	509·6	326·6	180·1	Not rigged, but ballasted to trim.
,,	9·375	,,	,,	3·01	1·06	3·03	1·89	5·45	780·4	434·8	271·3	151·1	Ditto ditto.
	{ estimated at 6· }												
	5·936	3·64											
372	{ estimated at 3·5 }	5·32											Rigged and fully equipped for sea.
													Not completed.
													Engines appropriated to Simoom.
312	13·324	5·84	1·5	3·2	1·79	4·2	5·08	11·94	1322	464·8	562·6	197·9	Not rigged, light.
,,	11·891	,,	1·29	2·74	1·56	3·79	3·91	9·52	1077·2	428·9	443·2	176·5	Rigged and fully equipped.
													Engines appropriated to Vulcan.
1418	9·59	5·69	0·93	2·72	1·34	3·76	1·71	4·8	655·2	513·8	234·4	183·8	
1153		5·28											Not completed.
1846	{ by Log 7·5 }	3·8	1·25	4·08	0·55	2·09			768·7		201·7		Rigged and fully equipped for sea.
1090		3·83											Engines appropriated to Sans Pareil.
,,	8·855	,,	0·93	2·54	0·64	2·24	1·41	4·97	1085·9	490·8	309·2	139·8	With Archer's engines.
													Not completed.
	{ estimated at 6· }												
395		5·47											Engines not appropriated.
,,	10·241	,,	1·2	2·77	0·91	2·61	2·42	6·9	1175·3	444·4	411·7	155·7	With Seahorse's engines.
303	9·137	9·3	1·11	5·15	1·22	2·89	2·86	6·79	625·5	266·7	263·5	112·3	Not rigged, but ballasted to trim.
,,	4·515	,,	0·73	4·17	0·12	0·29	0·38	0·91	754·7	238·8	317·9	100·6	Ditto ditto.
,,	5·148	,,	0·73	4·17	0·12	0·29			1118·7		471·2		Ditto ditto.
039		5·76											Not completed.
072	9·494	5·6	1·36	3·28	0·99	3·25	2·05	6·74	862·2	416·6	262·9	127	Rigged and fully equipped for sea.
,,	10·427	,,	,,	3·19	1·02	3·32	2·34	7·63	1111	483·2	341·5	148·5	Ditto ditto.
,,	8·708	,,	,,	3·47	0·94	3·12	1·47	4·89	703·9	448·1	211·9	134·9	Ditto ditto but very deep.
809	7·106	5·48	1·05	3·06	0·75	2·27	1·1	3·34	478·9	325·6	158	107·4	Not rigged, but ballasted.
,,	7·686	,,	0·92	2·99	0·76	2·32	1·39	4·19	592·	326·6	196·1	108·2	Rigged.
,,	8·74	,,	0·81	2·97	0·79	2·38	1·49	4·48	839·7	446·5	280·2	149·	Ditto.
490	6·369	5·09	0·77	3·45	0·27	0·86	0·55	1·74	945·6	477·0	300·5	148·1	Not rigged, but ballasted to trim.
,,	7·418	,,	0·62	3·2	0·29	0·91	0·72	2·34	1387·8	562·2	450·5	182·5	Rigged and partially equipped.
,,	6·497	,,	,,	3·78	0·25	0·79	0·62	1·99	1101·5	442·1	343·7	137·9	Rigged and fully equipped for sea.
,,	7·228	,,	0·52	3·48	0·28	0·88	0·66	2·05	1327 4	571·2	426·6	183·7	Ditto ditto.
888	10·074	5·39	1·1	3·49	0·73	2·19	1·56	4·69	1400·6	654·5	465·8	217·7	Not rigged, but ballasted.
,,	9·639	,,	,,	4·2	0·6	1·9	1·32	4·15	1477·7	676·7	470·8	215·6	Rigged and fully equipped for sea, 6 in. false keel added on.
516	8·238	5·3	0·91	3·06	0·32	0·98	0·89	2·69	1714·4	624·6	569·6	207·5	Not rigged; light.
,,	7·3	,,	0·81	3·55	0·27	0·84	0·69	2·15	1439·3	562·2	463·3	181	Rigged and fully equipped for sea.
486	8·096	5·64	1·12	3·44	1·15	3·24	2·01	5·65	459	563·6	163·6	93·8	Prior to stern being made finer. Rigged and ballasted.
,,	9·499	,,	1·12	3·44	1·15	3·24	2·12	5·95	741·4	404·1	264·2	144	Subsequent ditto ditto ditto.
,,	8·011	,,	1·12	3·48	0·57	1·61	2·12	3·04	899·7	478·6	318·2	169·3	With Teazer's engines ditto ditto.
,,	7·977	,,	1	3·12	0·5	1·46	0·95	2·78	1010·1	531·9	346·9	182·6	Ditto ditto ditto ditto.
334		3·84											With Horatio's engines, not completed.
													Engines appropriated to Megæra.
503	9·782	5·63	1·12	3·81	1·04	3·15	2·12	6·43	898·6	440·4	296·8	145·4	Not rigged, but ballasted to trim.
,,	9·189	,,	1	3·08	1·02	3·1	1·86	5·66	760·4	416·4	250·2	137·0	Rigged and partially equipped.
980		5											Engines not appropriated.
,,	8·747	,,			0·63	1·81	0·99	2·83	1061·2	677·5	370·8	236·7	With Eurotas's engines.
296	6·315	5·96	1·29	5·21	1·2	2·88	2·11	5·05	208·8	118·9	87·6	49·9	Not rigged, prior to stern being made finer.
,,	7·685	,,	1·4	4·22	0·48	1·15	1·54	3·68	940·6	293·4	394·5	123·1	Ditto subsequent ditto.
547	9·166	5·19	1·16	2·74	1·2	3·84	2·4	7·72	642·2	319·7	200·4	99·8	Not rigged, but ballasted to trim.
,,	6·518	,,	,,	3·09	1·06	3·47	1·25	4·11	258·8	218·6	79·1	66·8	Trial not considered satisfactory.
,,	8·554	,,	,,	3·08	1·07	3·48	1·56	5·11	586·1	400·3	179·4	122·6	Rigged and equipped for sea.
,,	8·41	,,	,,	3·09	1·06	3·47	1·89	6·19	560·3	314·1	171·3	96·1	Ditto ditto.
,,	9·51	,,	1·11	3·11	1·05	3·45	2·3	7·53	814·9	373·9	248·8	114·2	Ditto ditto.
	{ estimated at 3·5 }												Rigged and fully equipped for sea.
764		5·31											Engines not appropriated.
,,	9·605	,,	1.18	3·02	0·75	2·15	1·7	48·7	1177·2	519·6	412·0	181·8	With Forth's engines; not rigged, but ballasted.
970		5·32											Engines not appropriated.
,,		,,											With Minx's engines, not completed.

Numbers showing the relative performance of the vessels, assuming the speed to vary directly as the cube root of the power, and inversely as the cube root of the Area of the Midship Section / Displacement.

rds.

ON THE INTRODUCTION AND PROGRESSIVE INCREASE OF SCREW PROPULSION IN HER MAJESTY'S NAVY.

Although various propositions for many years were made from time to time to use the screw as an instrument of propulsion, and a great variety of experiments tried in bygone days [illegible]

[illegible]

NAME.	Name of Manufacturer.	Description of Engines.	Cylinders.	Date of Contract.	Tonnage.	Speed per hour (Knots).
AJAX	Maudslay, Sons & Field	Horizontal	4	October 1845	1761	6·458
Ditto	Maudslay, Sons & Field	Horizontal	4	October 1844	"	7·147
AMPHION	Miller, Ravenhill & Co.	Horizontal	2	June 1841	1474	6·75
ARCHER	Seaward & Capel	Horizontal	2	August 1847	910	
Ditto	Miller, Ravenhill & Co.	Horizontal	2	August 1845	"	7·818
ARROGANT	John Penn & Son	Horizontal trunk	2	October 1845	1872	8·295
BEE	Maudslay, Sons & Field	Beam	1	May 1841	43	6·822
BLENHEIM	Seaward & Capel	Horizontal	4	October 1845	1832	5·810
BRISK	Scott, Sinclair & Co.	Horizontal	2	August 1847	1014	
CONFLICT	Seaward & Capel	Horizontal	4	October 1845	1038	9·280
CRACKER	G. & J. Rennie	Horizontal	2	August 1847		
DAUNTLESS	Robert Napier	Horizontal	2	October 1845	1497	7·360
Ditto	Robert Napier	Horizontal	2	October 1845	1500	10·293
DESPERATE	Maudslay, Sons & Field	Horizontal	4	October 1845	1037	9·432
DWARF	G. & J. Rennie	Vertical	2	May 1842	164	10·537
EDINBURGH	Maudslay, Sons & Field	Horizontal	4	October 1845		
ENCOUNTER	John Penn & Son	Horizontal trunk	2	October 1845	953	10·234
Ditto	John Penn & Son	Horizontal trunk	2	October 1845	"	9·313
ENTERPRISE *Pinnace*	Beale	Rotary		January 1848		estimated at 6·
EREBUS	Maudslay, Sons & Field	Locomotive High Press.	2	March 1845	372	5·936 (estimated at 3·5)
EUPHRATES	Seaward & Capel	Horizontal	4	October 1845		
EUROTAS	Boulton & Watt	Horizontal Oscillating	4	October 1845		
FAIRY	John Penn & Son	Vertical Oscillating	2	Nov. 1844	312	13·324
Ditto	John Penn & Son	Vertical Oscillating	2	Nov. 1844	"	11·891
FORTH	G. & J. Rennie	Horizontal	4	October 1845		
GREENOCK	Scott, Sinclair & Co.	Horizontal	2	October 1845	1418	9·59
HIGHFLYER	Maudslay, Sons & Field	Horizontal	2	August 1847	1153	
HOGUE	Seaward & Capel	Horizontal	4	October 1845	1840	by Log 7·0
HORATIO	Boulton & Watt	Horizontal Oscillating	4	October 1845	1000	
Ditto	Seaward & Capel	Horizontal	2	March 1849	"	8·855
HORNET	Maudslay, Sons & Field	Horizontal	2	August 1847		
INVESTIGATOR *Pinnace*	Beale	Rotary		January 1848		estimated at 6·
MEGÆRA	Fairbairn & Sons	Horizontal	4	October 1845	1395	
Ditto	G. & J. Rennie	Horizontal	4	April 1847	"	10·211
MINX	Miller, Ravenhill & Co.	Vertical Oscillating	2	Sept. 1845	303	9·137
Ditto	Seaward & Capel	High Press. Horizontal	2	April 1849	"	4·515
Ditto	David Napier	Buffard's Disc Engine			"	5·148
MIRANDA	Robert Napier	Horizontal	2	August 1847	1039	
NIGER	Maudslay, Sons & Field	Horizontal	4	October 1845	1072	9·491
Ditto	Maudslay, Sons & Field	Horizontal	4	October 1845	"	10·427
Ditto	Maudslay, Sons & Field	Horizontal	4	October 1845	"	8·705
PHŒNIX	John Penn & Son	Vertical Oscillating	2	Dec. 1843	809	7·106
Ditto	John Penn & Son	Vertical Oscillating	2	Dec. 1843	"	7·060
Ditto	John Penn & Son	Vertical Oscillating	2	Dec. 1843	"	8·24
PLUMPER	Miller, Ravenhill & Co.	Vertical Oscillating	2	August 1847	490	6·369
Ditto	Miller, Ravenhill & Co.	Vertical Oscillating	2	August 1847	"	7·418
Ditto	Miller, Ravenhill & Co.	Vertical Oscillating	2	August 1847	"	6·497
Ditto	Miller, Ravenhill & Co.	Vertical Oscillating	2	August 1847	"	7·228
RATTLER*	Maudslay, Sons & Field	Vertical	4	Sept. 1841	888	10·074
Ditto	Maudslay, Sons & Field	Vertical	4	Sept. 1841	"	9·849
REYNARD	G. & J. Rennie	Horizontal	2	August 1847	510	6·258
Ditto	G. & J. Rennie	Horizontal	2	August 1847	"	7·3
RIFLEMAN	Miller, Ravenhill & Co.	Horizontal	2	Sept. 1845	486	8·026
Ditto	Miller, Ravenhill & Co.	Horizontal	2	Sept. 1845	"	9·193
Ditto	Miller, Ravenhill & Co.	Vertical Oscillating	2	January 1848	"	8·011
Ditto	Miller, Ravenhill & Co.	Vertical Oscillating	2	January 1848	"	7·977
SANSPAREIL	Boulton & Watt	Horizontal Oscillating	4	Dec. 1845	2334	
SEAHORSE	G. & J. Rennie	Horizontal	4	October 1845		
SHARPSHOOTER	Miller, Ravenhill & Co.	Horizontal	2	Sept. 1845	503	9·782
Ditto	Miller, Ravenhill & Co.	Horizontal	2	Sept. 1845	"	9·189
SIMOOM	Robert Napier	Horizontal	2	October 1845	1980	
Ditto	Boulton & Watt	Horizontal Oscillating	4	February 1848	"	8·747
TEAZER	Miller, Ravenhill & Co.	Vertical Oscillating	2	Sept. 1845	296	8·313
Ditto	John Penn & Son	Vertical Oscillating	2	Nov. 1847	"	7·681
TERMAGANT	Seaward & Capel	Horizontal	4	October 1845	1547	9·161
Ditto	Seaward & Capel	Horizontal	4	October 1845	"	6·515
Ditto	Seaward & Capel	Horizontal	4	October 1845	"	8·554
Ditto	Seaward & Capel	Horizontal	4	October 1845	"	8·41
Ditto	Seaward & Capel	Horizontal	4	October 1845	"	9·51
TERROR	Maudslay, Sons & Field	Locomotive High Press.	2	March 1845		estimated at 3·5
VULCAN	Boulton & Watt	Horizontal	4	October 1845	1764	
Ditto	G. & J. Rennie	Horizontal	4	April 1847	"	9·005
WASP	G. & J. Rennie	Horizontal	2	August 1847	970	
Ditto	Miller, Ravenhill & Co.	Vertical Oscillating	2		"	

[illegible]

* RATTLER.—The numbers in the last four columns are higher than they should be, owing to the displacement and midship section having been calculated on the supposition that the depth of false keel at the time of these trials was the same as it was made afterwards.

S.			PROPELLER.										RATIO OF							
…on the Safety-valve.	Horse-power. Nominal.	Horse-power. Indicated.	Dimensions. Diameter.	Dimensions. Pitch.	Dimensions. Length.	Centre above bottom of false keel.	Immersion of centre at the time of Trial.	Number of Revolutions per minute.	Rate in Knots per hour.	Slip. In Knots per hour.	Slip. Per cent.	Vessel's length to breadth.	Screw's pitch to diameter.	Midship Section to screw's disc.	Indicated power. To Midship Section.	Indicated power. To Displacement ⅔	Speed ³ × Mid. Sec. / Indicated power.	Speed ³ × Dispt.⅔ / Indicated power.	REMARKS.
lbs.	hors	horses	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.		Knots.	Knots.									
20	100	360	10 0	11 1½	1 10	7 6	7 6	93	10·206	1·886	18·48	5·03	1·11	4·46	1·03	3·49	559·9	165·0	Wind No. 4.
35	200	597·3	12 0	12 3½	1 11	7 11	14 0	78	9·457	2·755	29·13	3·65	1·02	6·41	0·82	3·06	365·4	98·4	
50	200	500	12 0	9 6	1 7	7 10	14 1	80	8·340	1·815	21·76	3·63	0·79	6·69	0·66	2·51	420·6	110·6	Wind No. 2.
12	250	699·1	12 0¾	9 8½	1 8	9 0	7 4	101·16	9·688	0·688	7·10	5·28	0·80	3·92	1·56	5·00	467·2	145·9	
14	250	702	12 0¾	9 8½	1 8	9 0	8 4	106·74	10·222	0·823	8·05	5·28	0·80	4·17	1·47	4·79	563·0	173·0	
10	450	792·6	16 1	21 1⅝	3 2	11 5	12 5	47	9·799	1·990	20·31	3·80	1·31	3·93	0·99	3·77	480·0	126·5	Fully rigged and complete with sea stores.
10	450	797·3	16 0¾	18 9	3 4	11 5	12 5	56	10·357	2·029	19·59	3·80	1·17	3·97	0·99	3·77	583·2	153·4	Fully rigged and complete with sea stores.
10	450	857·4	16 1	21 1⅝	3 2	11 5	12 5	50	10·424	4·914	47·14	3·80	1·31	4·04	1·05	3·99	160·0	42·0	Wind No. 5.
10	450	964·4	16 1	21 5⅝	3 2	11 5	12 1	53·5	11·154	4·261	38·20	3·80	1·31	3·96	1·20	4·55	273·4	71·9	
13	250	553·1	14 0	13 0	2 2	10 0	8 8	80·37	10·306	1·451	14·08	3·83	0·93	2·54	1·41	4·97	490·8	139·8	Preliminary trial, vessel not in trim.
20	100	233·1	10 0	13 6	1 10½	6 9	8 0	71	9·455	1·705	18·03	5·02	1·35	4·13	0·72	2·36	647·0	197·0	
13	360	1080·7	16 0	16 0	2 8	10 7	7 8	67·7	10·685	0·012	0·11	4·24	1·00	2·61	2·06	6·34	589·5	191·7	Fresh breeze.
20	360	1245	16 0	16 0	2 8	10 7	11 7	68·8	10·858	0·579	5·33	4·24	1·00	3·57	1·74	5·74	625·5	189·2	Wind No. 6.
20	360	1296	16 0	16 0	2 8	10 7	11 8	70·25	11·087	1·238	11·17	4·24	1·00	3·72	1·73	5·79	551·4	164·9	Wind No. 5.
22	350	1191	11 0	21 3	3 0¼	6 9	5 11	77	16·140	—	—	6·63	1·93	3·00	4·18	11·14	—	—	Speed not taken on account of vessel being ordered away direct.
6	600	1543·6	17 0	24 4	3 1	12 2	11 8	51	12·241	2·880	23·53	4·15	1·43	4·58	1·48	5·31	552·7	154·3	Wind No. 4.
20	200	689·2	11 0	15 7½	2 6	7 1	4 5	85	13·101	2·080	15·88	6·35	1·42	2·53	2·87	8·13	466·2	164·7	Wind No. 2.
20	160	526·9	11 0	9 8½	2 4	7 1	4 6	113	10·821	—	—	6·32	0·88	2·23	2·49	7·47	—	—	Preliminary trial.
50	200	691	13 6	11 0	1 10¼	9 1	8 3	87·5	9·494	0·295	3·11	5·59	0·81	3·16	1·53	4·86	510·3	160·1	Wind No. 2.
50	200	551·4	13 6	11 0	1 10¼	9 1	8 10	84	9·114	0·441	4·84	5·59	0·81	3·27	1·18	3·79	553·7	172·3	Wind No. 8.
20	800	2239	19 1	26 9	3 6¾	12 8	9 4	50	13·193	2·133	16·17	4·01	1·40	3·26	2·40	8·17	563·8	165·6	Not rigged, her lower masts only being in place. Wind No. 4
20	800	2683·5	19 1	26 9	3 6¾	12 8	10 2	53·5	14·117	2·251	15·95	4·01	1·40	3·24	2·89	9·83	577·8	170·0	Wind variable, No. 1 to No. 2. [to No. 5.
8	350	925·6	14 5¼	16 0	2 8¾	8 7	6 8	74·21	11·711	1·470	12·55	5·47	1·11	2·34	2·42	6·90	444·4	155·7	
8	350	826·9	14 5¼	16 0	2 8¾	8 7	6 3	70	11·048	2·048	18·54	5·47	1·11	2·64	1·91	5·63	380·9	129·4	
50	150	529·6	6 0	12 6	– –	3 6	4 6	139	17·139	11·369	66·33	3·93	2·08	10·96	1·71	4·34	112·4	44·2	
50	150	498·1	6 0	12 6	– –	3 6	4 6	113	13·933	8·703	62·46	3·93	2·08	3·66	1·62	4·10	88·5	34·9	} Trial with three propellers, the centre one 12 ft. 6 in. pitch,
..	....	....	6 0	7 6	....	....	....	.....	8·360	3·130	37·44	....	1·25	....	....	....	....	....	} those on the quarters 7 ft. 6 in. pitch. Aggregate areas of
5	10	36·5	4 1	3 6¾	0 7	2 6	2 4	196	6·888	1·447	21·01	5·93	0·87	4·51	0·62	1·32	260·4	121·8	[discs taken in the calculation.
3	250	613·1	12 0	11 6	1 11	7 3	5 3	87·87	9·968	0·782	7·85	5·77	0·96	2·97	1·82	5·02	680·8	247·5	Speed by patent log. Wind No. 5, abeam. Propeller 11 in.
0	200	478	11 1	14 3	2 6¾	7 1	4 5	75	10·542	0·617	5·85	6·35	1·29	2·49	1·99	5·64	490·9	173·5	Wind No. 4. [out of the water. Negative slip.
20	200	641·5	11 1	14 3	2 6¾	7 1	4 5	88	12·370	1·649	13·33	6·35	1·29	2·51	2·65	7·54	464·9	163·5	Wind No. 2 to No. 3. [service.
8	400	792·4	12 6	17 4½	2 6	8 6	6 11½	70	11·997	2·091	17·43	5·60	1·39	3·31	1·95	6·41	498·1	151·7	Wind No. 3. Fully rigged and complete with stores for home
6	500	928	17 0	16 0	2 8	12 6	12 11¾	51·5	8·128	1·274	15·67	3·79	0·94	4·41	0·93	3·45	347·0	93·4	Wind No. 5 to No. 6.
0	600	2328·6	18 0	23 0	3 2	12 3	14 7	62·75	14·236	2·790	19·60	4·27	1·28	3·86	2·37	7·89	632·4	190·1	Wind varying from No. 1 to No. 3.
0	400	1324	16 0	23 6	3 0	10 7	9 2	59	13·677	2·364	17·29	4·96	1·47	2·69	2·45	8·04	590·5	180·2	
0	400	1097·6	16 0	25 6	– –	10 7	9 2	49	12·325	1·656	13·44	4·96	1·59	2·71	2·02	6·63	601·9	183·2	Griffiths's propeller.
5	200	572	12 0	12 0	2 0	7 11	12 1	82	9·706	2·104	21·68	3·63	1·00	5·84	0·87	3·13	506·9	140·2	Wind No. 2.
0	260	524·1	11 10½	9 10	1 7½	8 3	6 9	88	8·536	0·862	10·10	5·48	0·83	3·66	1·29	4·07	349·2	111·0	
0	350	1192·5	11 0	20 6	3 0	6 10	5 2	82	16·582	5·216	31·46	6·59	1·86	2·87	4·37	11·50	336·1	127·7	Wind No. 1.
0	350	1150	11 0	20 6	3 0	6 10	5 0	82	16·582	5·250	31·66	6·59	1·86	2·76	4·39	11·42	331·5	127·4	Wind No. 6 on the beam.
4	60	116	8 8½	6 0⅝	0 11⅞	6 1	4 6	108·75	6·492	0·459	7·07	5·09	0·69	3·16	0·62	1·86	544·3	180·7	Negative slip.
4	60	135	8 8½	6 0⅝	0 11⅞	6 1	4 6½	111	6·627	0·591	8·92	5·09	0·69	3·26	0·70	2·11	540·4	177·8	Wind No. 3 to No. 4. abeam. No guns on board. Negative slip.
0	400	1491	17 1	21 6½	3 0	11 10	9 9½	58	12·324	1·293	10·49	3·73	1·26	3·51	1·85	6·59	724·7	203·6	Wind No. 3 to No. 5.
0	350	1106	15 9	20 0	3 0	10 2	8 10	62·5	12·330	2·211	17·93	5·02	1·27	2·68	2·12	7·04	489·0	147·2	Wind No. 4.
0	200	499·7	10 0	11 0	1 3	7 0	5 1½	103·04	11·18	1·410	12·61	5·39	1·10	3·39	1·88	5·61	496·4	166·2	Partly rigged; no yards.
0	200	519·2	10 0	11 0	1 3	7 0	7 6	101·72	11·037	1·896	17·18	5·39	1·10	4·30	1·54	4·84	497·2	157·9	
0	100	166·5	9 0	8 5	1 5⅜	5 4	6 6	89·64	7·441	0·291	3·91	5·64	0·94	3·66	0·71	2·16	511·5	169·4	Fully rigged and ready for sea.
0	200	676·8	11 0	15 8½	2 6	7 1	4 2	84	13·016	2·192	16·84	6·35	1·43	2·35	3·04	8·47	417·8	149·7	Wind No. 1.
0	500	1800·6	17 0	19 2	3 2	12 5	14 11	69	13·045	3·045	23·34	3·82	1·13	5·11	1·55	5·73	644·2	174·5	Calm, smooth water. Ship fully rigged and equipped.
0	400	....	17 0	17 0	3 0	11 4	12 6	62	10·397	1·022	9·83	3·77	1·00	4·16	—	—	—	—	Speed could not be accurately ascertained. Mean of two runs. [Indicator broken.
0	200	578	12 0	9 6	1 7	7 10	14 11	97·5	9·137	2·457	26·89	3·65	0·79	6·76	0·76	2·84	394·0	104·9	Wind light and variable.
0	600	2136	18 0	21 8	3 6	11 9	13 3	61	13·037	1·838	14·10	4·30	1·20	4·19	2·00	6·99	701·6	200·9	Wind No. 1. 476 tons of coal on board.
2	350	622·4	16 0	16 0	2 8	11 5	10 6	49·5	7·812	0·762	9·75	3·83	1·00	4·38	0·71	2·99	495·4	117·1	
5	400	1471	16 0	23 0	3 0	11 5	14 2½	58	13·159	3·859	29·33	3·83	1·44	4·94	1·48	6·04	543·5	133·2	Speed by patent log. Weather calm, water smooth.
0	400	1362	16 0	23 6	3 0	10 7	5 9	63	14·604	3·204	21·94	4·96	1·47	2·01	3·37	10·39	439·5	142·5	Upper edge of propeller 2 ft. 4 in. out of the water. Wind No. [4, a little swell.
0	200	832·4	12 0	10 0	1 8	7 8	11 1	112·25	11·072	1·774	16·02	3·80	0·83	4·58	1·61	5·63	500·2	142·8	Wind No. 3.
0	600	2005·7	18 1	25 3	3 6	11 8	7 4	56	13·948	2·141	15·35	4·70	1·40	2·44	3·20	9·76	513·7	168·7	Upper edge of propeller 1 ft. 8½ in. out of the water. Wind [No. 4.
0	200	348	8 10	9 10⅜	1 5¾	5 3½	5 5½	114·75	11·166	1·839	16·47	5·65	1·12	3·88	1·47	4·62	553·7	175·5	
2	350	530·8	15 11½	16 6	2 7½	9 3	8 4	49	7·975	1·230	15·44	6·00	1·03	2·36	1·12	3·10	273·3	98·9	Trial not considered satisfactory.
0	350	539·6	15 11½	16 6	2 7½	9 3	8 7	52·5	8·545	0·202	2·36	6·00	1·03	2·78	0·97	2·78	688·5	240·5	Vacuum imperfect. Negative slip.
0	350	603·6	16 0	16 9½	2 9¾	9 3	8 11	52·5	8·696	0·000	0·00	6·00	1·05	2·92	1·03	2·98	640·6	221·0	
2	350	616	16 0	16 9½	2 9¾	9 3	10 4	50	8·282	0·356	4·30	6·00	1·05	2·68	1·04	3·02	480·1	165·1	Vessel not in trim. [much by the stern.
0	400	1242	15 11	24 7	2 8¼	9 3	9 11	55	13·337	2·690	20·17	6·00	1·54	2·90	2·15	6·21	561·7	194·4	Wind No. 4. Speed not considered an average, vessel being so
0	160	528	11 0	10 0	2 4	7 1	4 7	112	11·048	—	—	6·32	0·91	2·28	2·43	7·36	—	—	
0	200	725·6	11 0	14 3	2 7	7 1	4 4	92	12·932	1·867	14·44	6·35	1·30	2·53	3·02	8·56	448·1	158·3	Wind No. 2 to No. 3.
0	200	778·2	11 0	16 0	2 6	7 1	4 5	88	13·889	2·740	19·73	6·35	1·45	2·57	3·19	9·04	434·5	153·3	Wind No. 2.
0	60	182	9 0	10 9½	1 9¾	6 6	6 7	80	8·516	1·981	23·26	4·98	1·20	3·69	0·77	2·49	360·4	112·1	Wind No. 3 to No. 4.
4	620	1119	15 6¼	18 0	3 0	9 6	7 11	69	12·251	3·470	28·32	5·19	1·16	2·97	1·99	6·48	340·0	104·5	Wind No. 2 to No. 5. Variable.
5	400	1134	15 7½	24 0	2 10½	11 0	7 6	53	12·547	3·423	27·28	5·19	1·54	2·84	2·08	6·73	365·0	112·8	Wind No. 7 to No. 8. Weather unfavourable.
5	400	1082	15 7½	24 0	2 10½	11 0	7 8	53	12·547	2·954	23·54	5·19	1·54	2·88	1·96	6·34	450·4	139·3	Wind No. 3.
0	150	668·1	6 2⅝	13 11½	2 3¼	3 6	5 4	138	19·001	—	—	3·93	2·24	11·84	1·82	4·86	—	—	Speed not taken on account of vessel being ordered away direct.
0	300	730	14 1	17 7	2 10½	9 6	9 11	66·5	11·534	1·983	17·19	4·47	1·25	3·69	1·27	4·31	686·3	202·2	Wind No. 6.
0	300	1068	14 1	17 7	2 10½	9 6	9 10	72·5	12·575	2·157	17·15	4·47	1·25	3·71	1·85	6·28	611·9	180·2	Wind No. 2.
0	350	1165·9	11 0	20 6	3 0	6 9	5 3	82	16·581	4·998	30·14	6·63	1·86	2·78	4·42	11·51	351·9	135·0	Wind No. 1.
0	160	672·9	11 0⅜	14 10½	2 6¼	7 1	4 11	86·5	12·692	0·832	6·56	6·32	1·35	2·24	3·13	9·46	533·0	176·4	
0	350	836·8	14 5¼	16 3	2 8¼	9 2	10 3	66	10·579	1·643	15·53	5·31	1·13	3·33	1·54	4·57	464·7	156·0	Vessel not in good trim. Weather squally.
0	200	706·8	11 0	16 0	2 6	7 1	4 4	83·25	13·139	2·406	18·31	6·35	1·45	2·43	3·06	8·60	404·1	143·8	Wind No. 4 to No. 5.
0	100	185·8	11 0	13 6	2 0	8 0	5 6	53·32	7·100	1·072	15·10	5·51	1·23	3·49	0·56	1·76	391·4	124·6	
0	100	203·1	11 0	13 6	2 0	8 0	6 9	56	7·457	1·101	14·76	5·51	1·23	4·10	0·52	1·70	493·1	151·4	Complete with stores for sea.
0	160	611·7	11 0⅜	15 0	2 6¼	7 1	4 8½	83	12·281	—	—	6·32	1·36	2·26	2·82	8·52	—	—	Vessel not in trim.

THE ARTIZAN.

No. 194.—Vol. 17.—MARCH 1st, 1859.

ADMIRALTY EXPERIMENTS WITH SCREW STEAM SHIPS IN THE ROYAL NAVY—WITH THE OFFICIAL TABLES.

(Accompanied by eight pages of Tables.)

In the year 1850, the Admiralty caused to be printed a series of experiments upon screw propulsion as adopted in Her Majesty's Service in vessels of various classes; those experiments were extensive and elaborate, and the results were recorded in a tabular form, and were accompanied with some remarks "on the introduction and progressive increase of screw propulsion in Her Majesty's Navy."

In the year 1856, a second official report was made to the Admiralty on the results of trials made in H.M's. screw ships and vessels, being continuation of the tables printed May 1850. This, like the preceding report of results of trials, was printed, and a few copies very sparingly circulated, principally amongst official persons, but with strict injunctions as to their being considered private and confidential, and therefore not to be published. Like most "private and confidential" documents which have been printed, and an unnecessary amount of importance attached to their being held as secrets, and considered as the property of a Government department, these documents were to be seen in the hands of French and Russian engineers and Government officials connected with their navies, whilst it was forbidden by the Admiralty that any public or beneficial use should be made of these documents for the advancement of scientific knowledge, or the more rapid and thorough advancement of the application of the screw propeller in the mercantile marine of this country.

At the meeting of the British Association, held in Dublin in the year 1857, a committee was nominated by the mechanical section (Section G) to consider and report on the best means of obtaining and recording facts connected with the performance of steam vessels at sea, with a view to advance the science of naval architecture. This committee, upon being nominated, had to be confirmed by the council of the Association, but during the progress of the recommendation from the committee of Section G up to the council, other names (from another section) than those recommended by Section G were added to the committee, it having afterwards been stated, by way of explanation, that the officers of the British Association considered the objects of the committee to be of a statistical nature, and therefore to make room for members of the statistical committee, certain names recommended by Section G were struck out, whereupon several of the other members of the mechanical section, whose names were permitted to remain on the committee, declined to act, and so nothing material in the way of carrying out the original recommendation of the committee, resulted from the working of the committee as then constituted, but a report was issued by the acting members in conformity with the requirements of the association, which report, upon being read, produced considerable controversy in the mechanical section of the British Association when they met in September last year at Leeds, and out of this controversy resulted the re-appointment of the whole of the members of the original committee recommended by the Section, to whom were added several other members of Section G, and also several scientific noblemen and gentlemen, members of the association.

The Committee thus appointed under a resolution "That it is desirable to call the attention of the proprietors of steam vessels to the great importance of adopting a general and uniform system of recording facts of performance of steam-vessels at sea under all circumstances, and to report to the Association at its next meeting," immediately commenced active proceedings, Admiral Moorsom being nominated chairman of the committee. The first meeting was held in December last, at the room, 11, Buckingham Street, kindly lent to the Committee by Mr. Yates, one of the most active of the advocates for the introduction of the decimal system of currency, measurements, &c., into this country, and the committee has continued to meet monthly, a working sub-committee having met, almost without interruption, weekly.

One of the first matters brought to the notice of the committee was the existence of a vast number of figures and many valuable facts, in the form of printed tables of "Results of Trials made in Her Majesty's Screw Ships and Vessels;" and although several members of that committee had a copy of the printed tables, &c., issued by the Admiralty, yet each member so possessed felt himself precluded from giving to the committee, as a body, the advantage of a reference to those reports, the contents of which were patent to many of them. Although such information was undoubtedly public property, having been collected by public servants, at the public cost, with vessels, the property of the nation; and it might, therefore, be supposed for the public good, considering the vast interest of the commercial community engaged in maritime affairs, and to whose fostering care (almost exclusively) the Royal Navy is indebted for the introduction of the screw, as a propeller, instead of the old, cumbrous, and ill-suited means of propelling steam vessels of war, formerly exclusively in use in the Royal Navy of England; nevertheless, it seemed there was not only a total disregard of the commercial interest and the public good in the official withholding of the results of trials with the screw propeller in Her Majesty's ships, but also an unaccountable assumption of exclusive right of appropriation of whatever was likely to be useful in the way of experiment with steam vessels in the Royal Navy; for, as a rule, anything like a full and correct statement of the results of trials at the measured mile or elsewhere, even though it might be of importance to the reputation of the manufacturers of the engines, was absolutely forbidden.

The committee, foreseeing the advantage it would be to give publicity to those tables, that they might be taken for what they are worth, and that they might be applied by naval architects, marine engine builders, and steam ship owners, to their purposes, to the extent to which they could

RESULTS OF TRIALS MADE IN H.M.'S SCREW SHIPS AND VESSELS.

(BEING A CONTINUATION OF THE TABLES PRINTED MAY, 1850.)

The numbers in the last two figure columns of the Table show approximately the relative excellence, in respect of speed, of the forms of the various vessels, conjointly with the relative efficiency of the propeller, as adapted to each of them.

The formulæ by which the calculations are made, are founded on the assumption that the resistance of a vessel varies as the square of her velocity, and, therefore, that the power required to produce that velocity varies as the cube, and that the useful effect of the engine—that is, the effect which remains after deducting the power absorbed in overcoming friction, working air-pumps, &c.—bears a constant ratio to the power developed in the cylinder, known by the term "Indicated Horse Power." The resistance is, in the first of these columns, assumed to vary, *cæteris paribus*, as the area of the midship section, and in the last column as the square of the cube root of the displacement.

None of these assumptions, however, more especially the last two, are absolutely correct, but probably they are not so far from the truth as to render useless and uninteresting a comparison, of which they are the basis, made between the performances of any two screw vessels; while between two vessels which do not materially differ in engines and displacement, or in the area of their midship sections, such a comparison is not only highly interesting, but it may prove of great value in pointing out the forms of vessels and proportion of propellers which ought to be adopted. In some striking cases it is scarcely necessary to make any other comparison than that of speed. For example, as may be seen in the table printed in 1850, the *Teazer*, after her form had been improved, went above a knot an hour faster with 40 horse engines than she had previously gone with engines of 100 horse power. Again, these engines of 100 horse, when transferred to the *Rifleman*—a vessel approaching to double the tonnage—drove her, after her form had been altered, as fast as she was previously driven by engines of double the power, and nearly two knots faster than the same engines drove the smaller vessel before the alteration of her after-body.

Admiralty, August, 1856.

NAME.	Name of Manufacturer.	Description of Engines.	VESSEL (Tonnage, Speed, Date of Trial, Where tried, Length, Breadth, Draught of Water, Area of midship section, Displacement)	ENGINES (Cylinders, Horse-power)	PROPELLER (Dimensions, Slip)	RATIO OF	REMARKS.
AGAMEMNON	John Penn and Son	Horizontal, Trunk	[illegible]	[illegible]	[illegible]	[illegible]	Weather very favourable.
Ditto	John Penn and Son	Horizontal, Trunk	[illegible]	[illegible]	[illegible]	[illegible]	Weather very favourable.
ALACRITY	Miller, Ravenhill, and Co.	Horizontal	[illegible]	[illegible]	[illegible]	[illegible]	Wind No. 4.
ALGIERS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Speed by common log.
ARCHER	Miller, Ravenhill, and Co.	Horizontal	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ARIEL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Wind No. 7.
ARROGANT	John Penn and Son	Horizontal, Trunk	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ARROW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ASSURANCE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BEAGLE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Calm.
BRISK	Scott, Sinclair, and Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BRUNSWICK	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CÆSAR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CENTURION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fresh breeze, considerable swell.
COLOSSUS	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CONFLICT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Boomerang propeller.
Ditto	Seaward and Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Seaward and Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Seaward and Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Seaward and Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CONQUEROR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
COQUETTE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CORNWALLIS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
COSSACK	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CRESSY	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CRUISER	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CURACOA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CURLEW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DAUNTLESS	Robert Napier and Sons	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Robert Napier and Sons	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Robert Napier and Sons	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Robert Napier and Sons	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DESPERATE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DUKE OF WELLINGTON	Robert Napier and Sons	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
EDINBURGH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ENCOUNTER	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ESK	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
EXMOUTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FAIRY	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn and Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FALCON	Miller, Ravenhill, and Co.	Horizontal	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FLYING FISH	Maudslay, Sons, and Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Maudslay, Sons, and Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Maudslay, Sons, and Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Maudslay, Sons, and Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FORTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GLATTON, Battery	Miller, Ravenhill, and Co.	Horizontal, High Press.	[illegible]	[illegible]	[illegible]	[illegible]	Speed by common log.
HANNIBAL	Scott, Sinclair, and Co.	Horizontal, Geared	[illegible]	[illegible]	[illegible]	[illegible]	Speed by common log. Launching cleats not removed. [Negative slip.

NAME.	Name of Manufacturer.	Description of Engines.	VESSEL (Tonnage, Speed, Date of Trial, Where tried, Length, Breadth, Draught of Water, Area of Midship Section, Displacement)	ENGINES (Cylinders, Horse-power)	PROPELLER (Dimensions, Slip)	RATIO OF	REMARKS.
HARRIER	Humphrys, Tennant & Co.	Horizontal	[illegible]	[illegible]	[illegible]	[illegible]	Wind No. 4.
HASTINGS	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Wind No. 2.
HAWKE	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HIGHFLYER	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HOGUE	Seaward & Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Seaward & Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Seaward & Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Seaward & Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HORATIO	Seaward & Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HORNET	James Watt & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
IMPERIEUSE	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
INTREPID	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
JAMES WATT	James Watt & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LAPWING	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LYNX	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MALACCA	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MARLBOROUGH	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MEGÆRA	George & John Rennie	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	George & John Rennie	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
METEOR, Battery	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MINX	Seaward & Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MIRANDA	Robert Napier	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MOHAWK	Humphrys, Tennant & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Humphrys, Tennant & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NIGER	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NILE	Seaward & Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ORION	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PEARL	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PEMBROKE	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PHŒNIX	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PIONEER	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PLUMPER	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PRINCESS ROYAL	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PYLADES	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RATTLER	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RIFLEMAN	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RINGDOVE	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ROYAL ALBERT	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ROYAL GEORGE	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RUSSELL	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ST. JEAN D'ACRE	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SANS PAREIL	Boulton & Watt	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	James Watt & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SATELLITE	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SEAHORSE	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SHANNON	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SHARPSHOOTER	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SIMOOM	Boulton & Watt	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Boulton & Watt	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Boulton & Watt	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Boulton & Watt	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Portsmouth Yard	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SNAKE	John Penn & Son	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SPARROWHAWK	Humphrys, Tennant & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SURPRISE	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SWALLOW	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TERMAGANT	Seaward & Capel	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Portsmouth Yard	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Portsmouth Yard	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
THUNDER, Battery	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TRIBUNE	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VICTOR	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VIPER	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VULCAN	George & John Rennie	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WANDERER	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WASP	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ditto	Miller, Ravenhill & Co.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WRANGLER	Maudslay, Sons & Field	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

avail themselves of the information, passed a resolution several months ago, that they should memorialize the Admiralty with reference to obtaining permission to make a series of experiments of a thoroughly reliable character, and amongst other things, to obtain the publication of the various official papers, reports, &c., connected with trials of the vessels in the Royal Navy; and amongst those papers are the two official documents hereinbefore referred to, viz.: the first, dated May, 1850, and the second (being a continuation of the tables printed May, 1850), dated Admiralty, August, 1856.

The Committee on Steam Ship performance, having recently memorialised the Admiralty, and the prohibition to the publication of the two sets of tables just referred to, having been removed, we are now enabled to present to our readers, the two sets of tables which are issued, without additional charge, with the present Number. It should be observed that the Committee on Steam Ship performance, have for some time past had placed at their disposal, by us, copies of the tables in manuscript, for the purpose of reference, and we are now glad to be enabled to place those tables, for what they are worth, before our readers; at the same time expressing a hope that experiments on steam vessels, in the Royal Navy will in future be conducted not only publicly, or at least that the results may be available for the advancement of practical science, but also that other and equally important elements which are omitted to be given in the tables of 1850 and 1856, may in future be added to those which it is thought worth while noting for the purpose of drawing conclusions, by which the comparative merits of vessels and their machinery have to be judged. We more particularly refer to the entire absence of any details respecting the source of power—the boilers, the coal consumption, and other equally important elements for enabling practical men to arrive at useful conclusions respecting the relative and comparative merits of the steam machinery employed on board of vessels in Her Majesty's service.

In presenting our readers with these two sets of tables, we have made a transposition of some of the columns, as we had previously done in manuscript for our own convenience, but, with that exception, the tables are faithfully reprinted from the originals issued by the Admiralty.

In conclusion, we think it but fair to the members of the Committee of the British Association on Steam Ship Performance to state, that to them solely is due the credit for obtaining the publication of the official papers and tables of results of trials made in Her Majesty's screw-ships and vessels; and thus, by effecting one step in advance, they have paved the way for other material improvements.

COMMITTEE ON STEAM-SHIP PERFORMANCE.

The following circular letter and form have been issued by the Committee, and we call the attention of steam-ship owners, engineers, and steam-ship builders thereto, and express a hope that their cordial and zealous co-operation will be extended to the Committee:—

"The British Association, at its meeting at Leeds, appointed a Committee to call the attention of proprietors of steam-vessels to the 'great importance of adopting a general and uniform system of recording facts of performance of steam-vessels at sea under all circumstances, and to report to the Association at its next meeting.'

"The return is intended to contain such particulars of the trials in smooth water at the measured mile, as it is usual to obtain for the satisfaction of the designer of the vessel and the builder of the engines; and the Committee are aware that such particulars are usually confined to the knowledge alone of those persons.

"It is, however, well known that information respecting these trial-performances constantly appears in the newspapers, and that, not being authentic, and seldom furnishing all the requisite data, very erroneous conclusions are liable to be drawn from such statements.

"The Committee believe that authenticated facts recorded in the form proposed would materially aid the scientific naval architect and the practical shipbuilder, together with the engineer, in determining many elements which are at present held as opinions only, and about which considerable differences prevail.

"The object of the Committee is to make public such recorded facts through the medium of the Association, and being accessible to the public in that manner, to bring the greatest amount of science to the solution of the difficulties now existing to the scientific improvement of the forms of vessels and the qualities of marine engines.

"They will especially endeavour to guard against information so furnished to them being used in any other way, and they trust they may look for the co-operation of members of the Yacht Club having steam yachts, of shipowners, as well as of builders and engineers.

"The return of particulars of performance at sea will afford the means of making such comparisons with smooth-water performances as cannot fail to throw light upon qualities of vessels, which as yet are matter of speculation only.

"The names of the Members of the Committee are annexed.

Vice-Admiral MOORSOM, *Chairman.*

The Marquis of STAFFORD, M.P.	JAMES KITSON, C.E.
The Earl of CAITHNESS.	WILLIAM SMITH, C.E.
The Lord DUFFERIN.	JAS. E. McCONNELL, C.E.
Sir JAMES GRAHAM, Bart., M.P.	CHARLES ATHERTON, C.E.
WILLIAM FAIRBAIRN, F.R.S.	Prof. RANKINE, LL.D.
JOHN SCOTT RUSSELL, F.R.S.	JAMES R. NAPIER, C.E.

HENRY WRIGHT, *Secretary.*

"Committee Room, 11, Buckingham Street, Strand,
"London, March 1st, 1859."

RETURN OF PARTICULARS RESPECTING THE STEAM-SHIP————————

PERFORMANCE UNDER TRIAL.										ACTUAL MEASUREMENTS OF SHIP.					PROPELLERS.										ENGINES.	
															IF A SCREW.					IF PADDLE-WHEELS.						
Date and place of trial.	Force and direction of wind, tide, and sea.	Consumption of coal in getting up steam.	Ditto during the trial.	Evaporation of water during trial.	Indicated horse-power with diagrams.	Revolutions of the propeller during trial.	Measured speed in statute miles per hour during the trial with tide.	Ditto against tide.	Average speed of runs according to Admiralty practice, in statute miles and in knots.	Dead length and breadth on water-line when moored in still water.	Area of greatest section on trial.	Drafts of water on trial.	Displacement in tons on trial.	Calculated measure of stability, and other particulars usually entering into the calculation of the designer.	The dimensions & nature thereof, particularising the number of blades, diameter, pitch, area of blades, dimensions of boss.	Depth of immersion from top of blade to surface in still water.	Weight of screw.	Dynamometrical force expended during trial.	Measure of end thrust produced whilst under trial.	Diameter, length, breadth, and thickness of floats; number of floats.	What sort.	Weight of each wheel.	Depth of immersion on trial.	Dynamometrical force measured during trial on paddle-shafts.	Kind or description of engine.	Dimensions of cylinders.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
										OR, IF PREFERRED, THE LINES OF THE SHIP.																

THE "ARTIZAN" STEAM-SHIP.

(Illustrated by Plate, No. 140.)

The screw steam-ship *Artizan*, built by Messrs. Stothert and Marten, of Hotwells, Bristol, and named after our Journal, was fitted with horizontal direct-acting engines of 100 nominal H.P., having the cylinders on one side of the screw-shaft, and the condenser, with air-pumps and feed and bilge pumps (worked direct off the piston) on the other side, the steam being conducted to the condenser over the engines in large copper pipes, into which a portion of the injection is taken. They take up very little room in the vessel, and have an unusually long connecting-rod. Everything is arranged so that the different parts can be easily got at, and as the engineer stands upon the driving-platform, he can see the whole of his engines at work.

They have been at work for some time, and give the greatest satisfaction, making 120 revolutions per minute, without any accident or hot bearings since they were set to work.

The engines and machinery are very creditable specimens of the engineering ability of a young firm; and a reference to the accompanying Plate will show that considerable attention has been paid to the contrivance and arrangement of the engines, and for compactness they will bear comparison with the engines of other firms.

The following are the particulars of the ship and machinery:—

DIMENSIONS OF "ARTIZAN" SCREW-STEAMER.

Built by Messrs. Stothert and Marten; Engines by the same firm, of 100 H.P. nominal.

Length on deck, 170 ft. 6 in.; breadth of beam, 25 ft. 6 in.; depth of hold at ditto, 15 ft. 6 in.; length of engine space; 26 ft. 8 in. Tons:—hull, 454·29; engine-room, 145·37; register, N.M., 308·92; tonnage, B.M., 535$\frac{6}{94}$. Kind of engines, horizontal direct-acting; ditto boilers, tubular; diameter of cylinders, 37 in.; length of stroke, 1 ft. 10 in.; diameter of screw, 9 ft. 3 in.; length of screw, 2 ft. 8 in.; pitch of screw, 17 ft.; number of blades of screw, 2; number of boilers, 2; length of ditto, 8 ft. 8 in.; height of ditto, exclusive of steam-chests, 11 ft. 6 in.; number of furnaces, 6; breadth of ditto, 2 ft. 4 in.; length of fire-bars, 7 ft. 6 in.; number of tubes, 657; internal diameter of ditto, 2$\frac{1}{4}$ in.; length of ditto, 6 ft. 6 in.; diameter of chimney, 4 ft. 2 in.; height of ditto, 34 ft.; load on safety-valve in lbs. per sq. inch, 16 lbs.; contents of bunkers in tons, 40; draft forward, 4 ft. 6 in.; ditto aft, 12 ft. 6 in.

Frames—Shape, angle-iron, 3$\frac{3}{4}$ in. by 2$\frac{3}{4}$ in. by $\frac{1}{2}$ in. and 16 in. apart; number of strake of plates from keel to gunwale, 6; thickness of plates, $\frac{7}{16}$ in. to $\frac{9}{16}$ in.; number of bulkheads, 3; diameter of rivets, 1$\frac{1}{8}$ in. to $\frac{3}{4}$ in.; distances apart, 2$\frac{1}{4}$ in.; part single and part double riveted; depth of keel, 7 in.; dimensions of ditto, 7 in. by 2$\frac{1}{2}$ in.; masts, 3; rig, three-masted schooner.

Intended service—Iron ore trade.

Classed at Lloyd's for twelve years A 1.

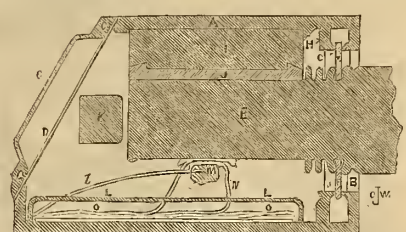
Remarks—She has a ballast tank, containing 150 tons of water; length, 28 ft.; depth, 10 ft.; area of mean section of ditto, 223·4.

Girt of midship section of ship on the ribs, from centre of keel to underside of the deck at side, 26·6½.

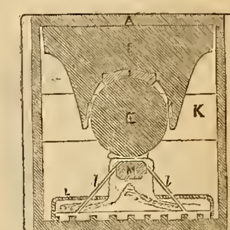
HOPKINS'S PATENT JOURNAL-BOX.

The accompanying illustrations exhibit views of "Hopkins's Improvements in Journal-Boxes." The novel features claimed for this invention are the introduction of diaphragms, to prevent the ingress of dust or grit to the box, in combination with an elastic rubber or lubricator, by which the oil or lubricating material (contained in a small reservoir in the bottom of the journal-box) is, by capillary attraction, fed to the bearing or journal. Fig. 1 being a vertical section of a railway journal and box, and Fig. 2 a transverse section of Fig. 1; A being the housing or casing of the box; B, the opening through which the journal end, E, passes; F being a leather diaphragm or collar, working in one of the three grooves G,—of which diaphragms or collars there may be more than one (and it is advisable to apply at least a second, to fill the space H); I is the top block, which receives the bearing; J being a white-metal or brass lining; K, a block-piece or cross-bar, for receiving the end-thrust and occasional wear of the axle (this piece is moveable, but is securely held within the housing or box); L is a moveable pan or cover, to protect the loose cotton, O, from dust; M, a pad or rubber of woollen or other material, which is mounted upon the moving arm *l*, which may be a steel spring, the rubber being kept in contact with the underside of the journal by the spring-arm, *l*; N being the capillary feeder, which may either be a flat band or a series of threads, the lower ends of which dip into the oil-pan or reservoir.

Fɪɢ.I.



Fɪɢ.II.



The end cover, C, is perforated, and lined inside with wire-gauze and open-woven cloth, or other similar material; D being a porous diaphragm stretched over the entire surface of the end cover.

These journal-boxes have been in use in America for several months, running 400 to 500 miles every 24 hours; and it is certified, by some American railway authorities, that these axle-boxes have run over 6,000 miles without more than half exhausting the oil filled into the reservoir before starting.

—WHILST UNDER TRIAL.

ENGINES—*continued.*													BOILERS.															
If steam-jacketed.	Number of cylinders.	Kind of condenser and cubic contents.	Ditto of air-pump and cubic contents.	Description of valves and areas of passages.	Total weight of engine.	Speed of piston in feet per minute, or number of revolutions per minute.	Temperature of feed-water.	Distance of engine from screw-propeller.	Nominal horse-power according to maker's contract.	Indicated horse-power at time of trial, with diagrams taken simultaneously at the top and bottom of cylinders.	The pressures of steam at the same instant in the boiler, and before the throttle-valve, by guages.	The vacuum in condenser and *external* atmospheric pressure, by guages.	Number of boilers (or pieces).	Description of boilers.	Dimensions of ditto.	Total weight of boilers with and without water.	Dimensions of steam-room and water-room in cubic feet.	Number of furnaces.	Dimension of grate surface, tube surface, and other heating surface.	Cubic contents of combustion-chamber and furnaces.	Distance of fire-bars from top of furnace.	Ditto of bars from top of ash-pit.	Actual air-space through fire-bars.	Description and dimensions of flues.	Number, length, internal and external diameter and material of tubes.	Number and dimensions of chimneys.	Load on safety-valve.	Consumption of coal per hour.
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56

THE PATENT HOIST GOVERNOR.

The principle of this invention is that of making the hoist box or cage used in mills, warehouses, and mines of every description, its own governor and regulator. This is accomplished by a pair of governor balls (similar to those used in ordinary steam-engines), attached to the top of the hoist-box, which acquire a momentum through the medium of a friction roller, which constantly rests against the guide or side of the shaft or well-hole, and by a driving-band communicating therefrom to the governor. Should the hoist box or cage ever attain a speed above that to which it is originally regulated to travel at, the immediate action of the governor brings into operation cams and catches, which, upon being once brought into contact with the ordinary sides or guides of the hoist, instantly retard the descent of the box; and the cams and eccentric feet, upon being brought into operation, are not dependent upon any artificial pressure, such as springs, levers, &c., but exert their retarding force according to the weight of the box or cage. For example:—Let any hoist box or cage be regulated to travel, say, at 80 or more feet per minute, as desired: so long as this speed is not exceeded, the governor will admit of the free working of the hoist, but should the descending box from any cause acquire a greater velocity, the friction roller immediately imparts an accelerated motion to the governor, which disengages a trigger, and allows the machine to come into action, so that the box cannot but be retained in position at the instant the regulated speed has been exceeded.

It is well known that several methods have been employed to sustain the box in the event of rope breaking, but, whereas nineteen accidents in every twenty happen from other causes than the breaking of the rope, the methods hitherto adopted are unsafe and not to be depended upon; and the patentees of the Hoist Governor assert, that, with this governing apparatus applied, the box or cage cannot be made to descend (let what will occur to engine, ropes, wheels, or gearing) at a quicker speed than that to which the box is restricted by the application of the governor.

Having been invited to witness the operation of the Patent Hoist Governor at the warehouse of Messrs. Watts and Co., Portland-street, Manchester, we visited Manchester expressly for that purpose; and having personally tested the working of the apparatus in the severest manner possible, we consider it a duty to mine-owners, and the proprietors of warehouses and mills having hoists, to urge upon them the application of an apparatus at once so efficient and inexpensive.

For the information of the mechanical portion of our readers, we give herewith three illustrations of the Safety Hoist Governor apparatus, applied to a warehouse hoist, which views are sufficiently explanatory of the action of the apparatus to render any further textual description unnecessary.

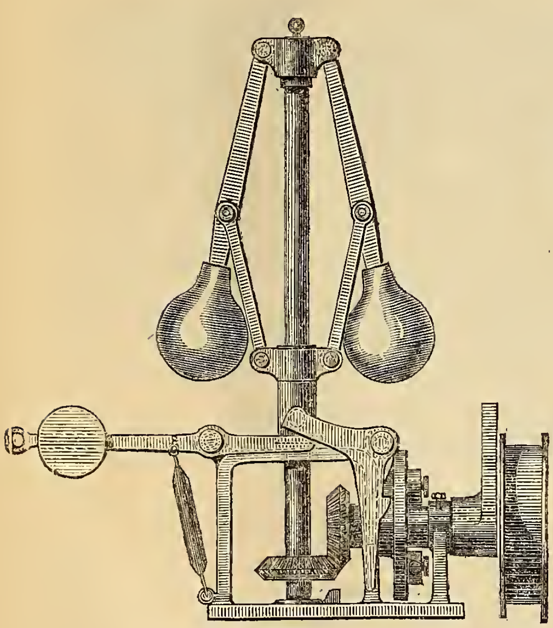


Fig. 1.

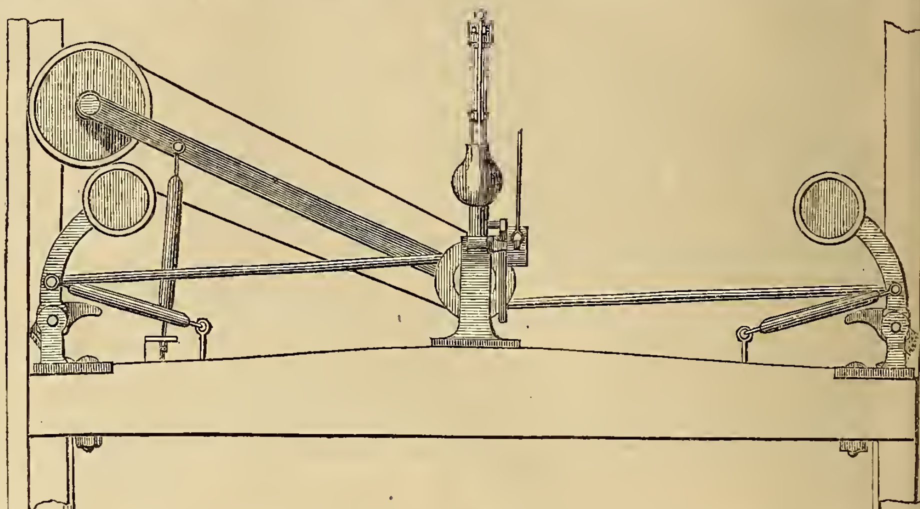


Fig. 2.

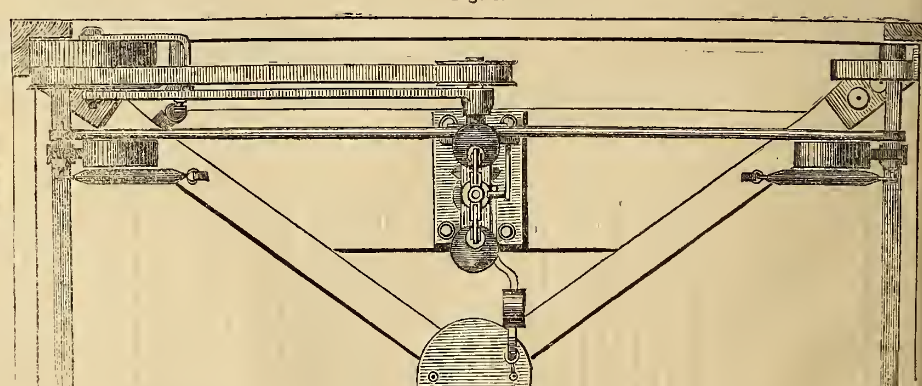


Fig. 3.

ACCIDENTS AND OCCURRENCES IN THE UNITED STATES IN JANUARY, 1859.

In the "Philadelphia Press" for January 3rd we are informed that about 40 miles of the Georgia railroad track have been washed away by the recent flood at different points. It adds that on the previous Friday a train of cars was thrown off the rails near Columbus, owing to the washing away of the track, and precipitated a distance of 30 ft. into the stream; twelve dead bodies have been recovered, and seven persons are still missing.

In the "Philadelphia Evening Argus," January 3rd, is given the following list of disasters to steamers on the western rivers during the year 1858:—

Burned	27
Sunk on rocks, snagged, or run ashore	108
Collisions	27
Explosions	10
Number of lives lost	346

Aggregate value of loss, 1,414,000 dollars.

From the "Philadelphia Press," January 11th, we learn that the boiler at the lard-oil mill of Joseph Whitaker, on Broadway, Cincinnatti, exploded on the morning of the 10th of January, severely injuring seven persons. The concussion was tremendous, lifting up the floors, and forcing out all the doors and windows in the rear and front of the building. The damage to the property will not exceed 1,200 dollars.

The "Philadelphia Ledger" of January 17th states a terrific explosion of a boiler occurred at Mr. Wells' grist and saw mill, at Hampstead, Kent, county Virginia, on the 10th inst. Five slaves were killed.

The "Baltimore Sun" of January 21st states that the Winans "Cigar" steamer has been on her trial trip, and with a pressure of steam of 56 lbs. per in. (half the pressure intended to be used on her voyages), an average speed of 12 miles per hour was obtained; and that in every respect the performance of the vessel was satisfactory to the enterprising projectors. (To an outsider, the speed obtained does not indicate much probability of her making the run from New York to Liverpool in six days.)

The "Philadelphia Ledger" of January 25th informs us that the U.S. steam-frigate "Niagara" (of cable-laying celebrity) is now lying at New York, and has had her engines taken out for the necessary repairs to be effected on them. (So young a vessel ought not to require such extensive repairing to her engines as this would indicate.)

The "Philadelphia Press" of January 29th says that the throttle valve of the steamer "Onward" burst, near Albany, on the Willamette, Oregon, and scalded five of the crew; two of them are reported to have died.

The "Baltimore American" states that during the past few days it has been reported that the Winans "Cigar" steamer is to be lengthened 28 ft., 14 ft. each end of the wheel, for the purpose of increasing her speed. (*We wish they may obtain it!*)

As a matter of scientific interest to English engineers, I send you the following extract from the "Public Ledger and Daily Transcript" of the 5th February :—

"*New Steam Generator.*—One of James Black's new steam generators, for which a patent was recently granted to Scott, Todd, and Co., of this city, has just been put in operation at the foundry of Morris, Tasker, and Morris. The novelty of the invention consists in injecting into a suitable generator a mixture of atmospheric air and water, by which steam is obtained for mechanical purposes of a greater tensive force, it is said, with a given quantity of fuel, than from water alone. The generator referred to consists of two vertical conical coils made of 2-inch lap-welded pipe, 30 in. in diameter at base, and 20 in. at the top, connected to a horizontal steam-drum, 6 ft. long and 17 in. diameter. The air and water is forced into the lower ends of the coils in graduated quantities, where it is almost instantly vaporized. The coils are suspended in a stack over grate-bars having a square surface of 7 ft. The generator, which was put up for 15 H.P., has been found to generate steam for 25. Among the advantages claimed for it, are—a great saving in fuel, exemption from danger by explosion, saving of space by its compactness, dispatch in raising steam, and greater durability than other boilers. Its non-explosive property arises from the fact that the coils will bear a pressure of 2,000 lbs. to the square inch, and that the almost instantaneous vaporization of the water and air leaves no water in the generator. Fifteen minutes is required for raising steam, and the inventor claims that the highest pressure may be attained with safety. The claim of durability is founded upon the absence of flues to collapse, or joints to burn out."

By the way, to show you we are getting rid of the old savage "Biler Buster," the above extract from the "Ledger" explains the plan of expanding common atmosphere with steam, which you see is done by injecting a little water with the air. This plan, however, although it will cut down the quantity of fuel ordinarily used to about one-half, does not equal by a vast deal the advantages of another plan, which I have before described to you; for the following reasons :—First, it requires 212 degrees of heat to cause water to commence expanding, or to change it to a state of vapour, and then some hundreds of degrees of heat still added to that, in order to give the same vapour a powerful expansion to drive the engine. But by the other plan, you will observe that the atmosphere *is already* in a suspended or vaporous state, and at a low temperature—say of 32 to 70 degrees,—and hence ready to expand at any increase of temperature upon that; so that by the time it receives heat to that degree which boils water, the expansion is already sufficient to drive the engine. In fact, but a moment elapses after the application of the fire to the charger or heater, before the engine is "off." I tried an experiment of this kind, and, starting with everything *cold*, at exactly the ninth *second* the engine moved off with considerable speed.

Mr. Ericsson proves that common atmosphere is quite sufficient to drive engines for many purposes, and is continually constructing them, and sending them all over the world, and is at this time dispatching a very nice one to Rome. The Ericsson engine is desirable where water is not conveniently available; but so little water is required in the new plan, that the latter must take the universal lead, as that little imparts to the engine all the power of the ordinary steam engine, particularly since it can be run with about one-eighth of the fuel. In fact, 10 tons of coal per day would be quite sufficient to drive the "Persia" or "Adriatic." You may call this crazy, or what you will, but it is nevertheless true.

AMERICAN NOTES FOR 1859.

No. II.

DIMENSIONS OF NEW STEAMERS.

DIMENSIONS OF STEAMER "AMONA."

Hull built by Harlan, Hollingsworth, and Co., Wilmington, Del.; Engines, ditto.

	Ft.	In.
Length on deck	201	6
Length at load line	200	0
Breadth of beam (moulded)	34	0
Depth of hold	10	0
Depth of hold to spar deck	17	6
Length of engine-room	75	0
Area of immersed section at load draft	228	0
Hull	632	tons.
Engine-room and bunkers	236	tons.

Description of engine, vertical beam condensing; ditto of boiler, one flue, return; diameter of cylinder, 3 ft. 8 in.; length of stroke, 11 ft.; diameter of water wheel over boards, 30 ft.; length of wheel blades, 6 ft. 6 in.; depth of ditto, 1 ft. 10 in.; number of ditto, 26; number of boilers, 1; length of ditto, 24 ft.; breadth of ditto, 15 ft. 6 in.; height of ditto, exclusive of steam chimney, 7 ft. 7 in.; number of furnaces, 4; breadth of ditto, 3 ft. 5 in.; length of grate bars, 6 ft. 2 in.; number of flues above, 8; ditto below, 8; internal diameter of ditto above, 1 ft. $5\frac{3}{4}$ in.; ditto below, oval, 1 ft. 6 in. by 2 ft.; length of ditto above, 19 ft. 2 in.; ditto below, 15 ft. 6 in.; diameter of smoke pipe, 5 ft. $3\frac{1}{2}$ in.; height of ditto, 33 ft. 8 in.; draft forward, light, 4 ft. 6 in.; load, 7 ft.; ditto aft, light, 5 ft. 2 in.; load, 8 ft.; date of trial, January, 1859; heating surface, 1,880 sq. ft.; consumption of fuel per hour, $\frac{7}{8}$ tons; maximum pressure of steam, 30 lbs.; point of cutting off, 5 ft. 6 in.; geared direct; maximum revolutions at above pressure, $17\frac{1}{2}$; speed in knots with tide, $14\frac{1}{2}$; ditto against, 10; weight of engine, 360,000 lbs.; ditto boiler, with water, 130,000 lbs.

Frames, bar iron (Fig. 1); depth, $3\frac{5}{8}$ in.; width of web, 1 in.; number of strakes of plates from keel to gunwale, 12; thickness of plates, $\frac{1}{2}$ in., $\frac{7}{16}$ in., and $\frac{3}{8}$ in.;


Fig. 1.

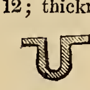


Fig. 2.

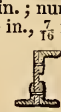


Fig. 3.

description of cross floors, bar iron, 1 in. by $3\frac{5}{8}$ in., and 11 cross keelsons 20 in. high, with angle iron on top of ditto (see Figs. 1 and 2); depth of keel, 5 in.; diameter of rivets, $\frac{3}{4}$ in. and $\frac{5}{8}$ in.; distance apart, 2 in.; single riveted; keel double, upper plate single; independent steam, fire, and bilge pumps, 1; boilers, chimney, and smoke pipe, how protected from communicating fire, felt and iron; masts, 2; rig, schooner; number of bulkheads, 4.

Intended service—New Orleans to Brazos.

Remarks—Flange iron clamp around the gunwale of ship made of sheet, 24 in. wide, and $\frac{1}{2}$ in. thick, with wrought-iron knees to each frame, and 12 fore and aft keelsons, 20 in. high.

DIMENSIONS OF STEAMER "KENSINGTON."

Built by Birely and Lynn, Philadelphia; Engines by Reaney, Neafie, and Co., Philadelphia.

	Ft.	In.
Length on deck	208	0
Breadth of beam	31	0
Depth of hold	18	0
Depth of hold to spar deck	25	0
Hull	1050 tons.	

Kind of engines, vertical beam; ditto boilers, flued; diameter of cylinder, 56 in.; length of stroke, 3 ft. 8 in.; diameter of screw, 13 ft.; pitch of screw, 25 ft.; number of blades of screw, 4; number of boilers, 1; area of immersed section at load draft of 15 ft. 400 ft.; load on safety-valve in lbs. per sq. in., 15 lb.; date of trial, December, 1858; draft forward, 13 ft. 6 in.; ditto aft, 15 ft.; average revolutions, 50.

Frames, $14\frac{1}{2}$ in. by 10 in., and 12 in. and 28 in. apart. Number of bulkheads, 2; independent steam, fire, and bilge pumps, 1; masts, 3; rig, foretopsail schooner.

Intended service—Philadelphia to Boston.

DIMENSIONS OF STEAMER "BALTIMORE."

Hull built by John A. Robb, Baltimore; Engines by Murray and Haslehurst, Baltimore.

	Ft.	In.
Length on deck	150	0
Breadth of beam (moulded)	20	6
Depth of hold	8	6
Depth of hold to spar deck	15	0
Area of immersed section at load draft of 10 ft.	170	0
Hull } Engine-room }	452	tons

Description of engine, vertical direct; ditto boilers, horizontal tubular; diameter of cylinder, 35 in.; length of stroke, 2 ft. 3 in.; diameter of screw, 9 ft.; length of blades of screw, 2 ft.; pitch of screw, 18 ft.; number of blades of screw, 3; number of boilers, 1; length of ditto, 14 ft.; breadth of ditto, 9 ft.; height of ditto, exclusive of steam chimney, 11 ft. 8 in.; number of furnaces, 2; length of grate bars, 5 ft.; number of tubes above, 74; internal diameter of ditto above, $3\frac{3}{4}$ in.; length of ditto above, 10 ft.; diameter of smoke pipe, 46 in.; height of ditto, 34 ft.; draft forward, 9 ft. 6 in.; ditto aft, 10 ft. 6 in.; date of trial, December, 1858; heating surface, 1,000 sq. ft.; consumption of fuel per hour, 7 tons; maximum pressure of steam, 30 lbs.; point of cutting off, half; maximum revolutions at above pressure, 75.

Frames, moulded, 11 in.; sided, 8 in.; 27 in. apart from centres; depth of keel, 6 in.; independent steam, fire, and bilge pumps, 1; masts, 3; rig, schooner; number of bulkheads, 2.

Intended service—Baltimore to West Indies.

Remarks—Has two athwartship bulkheads.

DIMENSIONS OF STEAMER "WHITE CLOUD."

Hull built by Thomas Collyer, N.Y.; Engines by Morgan Iron Works, New York.

	Ft.	In.
Length on deck	180	0
Ditto at load-line	179	0
Breadth of beam (moulded)	30	0
Depth of hold	10	7
Depth of hold to spar deck	10	7
Area of immersed section at load draft of 5 ft. 6 in.	140	0
Hull } Engine-room }	550 tons	

Description of engine, vertical beam; ditto boilers, flue single return; diameter of cylinder, 44 in.; length of stroke, 10 ft.; diameter of water-wheel over boards, 26 ft.; length of wheel blades, 7 ft. 6 in.; depth of ditto, 3 ft.; number of ditto, 24; number of boilers, 2; length of ditto, 26 ft.; breadth of ditto, 8 ft. 6 in.; height of ditto, exclusive of steam chimney, 8 ft.; number of furnaces, 2 in each; breadth of ditto, 3 ft. 6 in.; length of grate bars, 7 ft.; number of flues above, 4; ditto below, 10; internal diameter of ditto above, 17 in.; ditto below, 10 in., 12 in., 12½ in.; length of ditto above, 19 ft. 7 in.; ditto below, 13 ft. 11 in.; diameter of smoke pipe, 5 ft.; height of ditto, 31 ft.; draft, 5 ft. 6 in.; date of trial, January, 1859; heating surface, 2284 sq. ft.; maximum pressure of steam, 30 lbs.; point of cutting off, variable; maximum revolutions at above pressure, 24.

Frames, moulded, 14 in.; sided, 5 in.; 26 in. apart from centres, and strapped with diagonal and double-laid braces, 3½ in. by 3-8th in.; independent steam, fire, and bilge pumps, 1; masts, 2; rig, schooner.

Intended service—Canton River.

Remarks—Water-wheel guards for half width extend fore and aft.

C. H. H.

ON THE ECONOMIC PERFORMANCE OF STEAM-SHIPS.

(Continued from page 35.)

The same calculation has been made with the square of the midship section shown by the line EM, and the result by the other line CD, and so this one has more obliquity. The first, viz., AB, was adopted as the expression of a common measure, and named by the author *utilisation relative*. According to that, the theoretical efficiency multiplied by 1,000, and divided by the beam, must give 9·64. If less, the ship is in bad working condition, and if more it is satisfactory.

This rule is not perhaps the true one, as it is based on the curve of M. Le Bouleur, but it is to be hoped that this has been traced with sufficient accuracy to believe that the proposed rule is not far from truth, and can be adopted for practice.

Should all that precedes be true, it is evident that, if instead of being calculated by the card, the efficiency is the result of the coal burnt, the correction applied to the power will hold good to the second, and give a common standard. So all ships would have the same propellers, lines of water equally good, and boilers making the same use of coal. The result would be a constant number and a right line.

But we saw that the midship section was good for comparing propellers and engines; the displacement $^{\frac{2}{3}}$ was the best to calculate the *economical efficiency*. It is evident that the correction applied to the first will be good for the second, and will give a method of comparing economically ships of various dimensions. The *utilisations economy in relatives* were calculated according to these principles, and the results put on the columns of various Tables, where the speed and quantity of coal burnt by nearly all the ships of the French Navy and Messageries Imperiales are to be found as the basis of all calculations made on the new principles established by Admiral Paris.

All data collected during many years, and calculated according to the adopted formula $\frac{V^3 \times D^{\frac{2}{3}}}{\text{coal} \times \text{beam}}$, have been put on the Plate III., where the vertical scale shows the displacement, ½ centimetre being equal to 100 tons; and the *utilisations relatives* are on the horizontal scale, where 1 centimetre is equal to one unity.

As the measures of this kind of efficiency have not been taken in similar circumstances, those observed during the trials have been distinguished from the results of common navigation by peculiar marks. The means expressed by vertical lines show 7·2 for the efficiency of ships of every size during their trials—that is to say, with smooth water, calm, all in good order, and generally coal of a good quality. Whereas, the mean of navigation is 6·2 for ships of 3,000 tons displacement and less. It will be remarked that men of war and large frigates are not placed according to their navigation. This has been done according to the difficulties of putting in order so many data, and the stoppage it would have produced for the publication of this new work. This is not to be rejected because the *utilisations economiques* of men of war are of a very low rate, according to the shortness of their hull, and bluff form of the bow. This is shown in Plate III., as the relative utilisations of men of war during their trials are not superior to those of ordinary steamships.

A general rule is concluded from all this: it is, that in the present state of things in France, and in the the trials, $\frac{V^3 \quad D^{\frac{2}{3}}}{\text{coal} \quad \text{burnt}}$ must give at least C^2, and the same calculation for seaservice gives only P^2. So there is a difference of v q, and it agrees with experience; however, they generally allow that to ensure the near speed of packets, a ship running 12 during her trial, has no more than 10 when running on a line of postal service. The lines traced on the Plate iii. are used in that manner to separate the good ships from the bad ones; and in the Plate it will be seen how many are far from the middle line on both sides; and it will be remarked that by this method the qualities of ships are more clearly shown than by the first plan.

There is also a peculiarity to point out: the results of experiments are not disposed in the same manner as those of navy returns. The first are evidently favourable to small ships, as it is shown also by Plate ii.; it is because they are much longer in proportion than of the old model men-of-war.

In utilisations so calculated to those calculated with midship section the advantage of long hulls is very evident, and it is a consequence of the use of displacement in the formula, and a proof of the utility of using $D^{\frac{2}{3}}$ to the enumerator, when the beam to the divisor establishes a compensation, which combination of data shows at once the advantages of a ship for transport, speed, and economy.

To show the advantage of small ships in experiments, the line *a b* has been drawn amidst all final rounds, and the line *c d* shows the mean of the position of crosses, and proves that if small ships are advantageous for smooth water experiments, it is far from being the same at sea; in which case *relative utilisations* are quite equal for all, as the small ships find more obstacles than large ones when working against heavy seas, and that what is a fair sea for the large is heavy for the small. It is also to be observed that these vessels are the first built, and not on so good lines as now, and also their machinery is quite old.

The proposed method will be a standard for the verification of the state of machinery or of that of the bottom, for if tried in a calm, a ship which had 10 for her coefficient of *relative utilisation*, gives no more than 8, she has lost 20 per cent. of her value. It is very important to possess an evident proof of decay, and to be forced to search for the cause. The first investigation must be directed to the boiler,—which is generally the cause of evil and of the overplus of expense: if it is clean, the evil is probably in the dirty state of the bottom, or in the bad order of the engine by leaks, worn bearings, or shafts out of truth. This kind of index will be useful for the captain to know the changes which have happened in his ship, and for experiments it gives a comparison. If less useful to the shipbuilder than the former formula of M. Bourgois, it is at least more important for the owner and the seamen when they take possession of a ship. It is to be hoped that the data collected by Admiral Paris will be observed with care by many others, and give to this method the certainty of a great many facts collected for the same purpose. It is in looking for the cause that there is a hope to find a remedy, inasmuch as the first one ignored, nobody thinks about the second.

The preceding observations have been ascertained by another combination. It has been by searching in the accounts of various trials in the French Navy how many horses of 75 kilogrammes per square metre of midship section were necessary to drive various ships at the speed of 19 knots: when it has been more or less, the correction has been made in proportion of cubes of speeds.

From these numbers it will be remarked that when the *Ariel* wants 37·8 H.P., of 75 kilogrammetres, to go at 12 knots, 28·5 are necessary to the *Impératrice Eugénie*, 24·6 to the *Algéziras*, and only 21·2 to the *Bretagne*: that is, that the speeds are quite in the inverse ratio of the beams. To prove this a Plate has been traced, giving not only the position of these numbers, but also those expressing the beams and the square root of the midship section. The data collected are not numerous enough, and they present an anomaly, their positions on the figure being a straight line, which continued till the level expressing the midship section of the *Leviathan*, would show that that admirable specimen of naval construction should want no more than 15 H.P., per square metre, to go at 12 knots. It will be very curious to collect many other facts to corroborate the proposition shown by these calculations, which are quite proved by other combinations, which will be seen at the end of this work.

Now having spoken of the *Leviathan*, it will be interesting to calculate what will be the speed of this remarkable ship. The power of the screw engines is 1,600 nominal H.P., and of the paddle engines it is 1,000. These 2,600 nominal H.P. will certainly perform the duty of 7,800 H.P. of 75 kilogrammetres, which divided by the midship section, *i.e.*, 163 square metres at the mean draught of 7·62 metres, gives 47·8 H.P. per square metre. We saw that the *Bretagne*, having 119 square metres, wants 21 H.P. to go at 12 knots, and that for the same speed 15 are enough for the *Leviathan*, that is, that the value of each of these increases in the ratio of 15 to 21; so the 7,800 H.P. will do the same service as 10,920 H.P., or 67 H.P. of 75 kilogrammetres per square metre. Then establishing the ratio of speed as the cubic root of powers, we find that the speed of the *Leviathan* will be 18·8 knots. But it must be considered that when using the midship section it has been very disadvantageous to the great ship, because, much sharper than those compared with, she has more than eight times her beam, when the *Bretagne* has only four times and a half.

The calculation, established in another manner and compared to *Napoleon*, will give almost the same result. So, considering only the nominal powers, and admitting that the horses of both machineries have the same effective value, we shall remark that *Napoleon* has 9·5 nominal horses per square metre, when the *Leviathan* has 15·94. The relative powers of ships are as 1 : 1·67. According to the rule of speed in ratio to square roots of power the *Leviathan* will have 14·8 knots, without taking her size into account. But these are enough to be counted, and as with equal relative powers the speeds are as the cube roots of linear dimensions,—(this principle is verified farther,—the *Leviathan* would perform 14·396 knots for the only advantage of greatness, but this is not advantageous, and the calculation being made with the length her speed will be 16·41: the mean is 14·83, which combined with her moving power, would give 17·4; when calculating with her length, it would be 19·5. The builder appears to hope more, because the paddle-wheels have 16·47 metres of effective diameter, or 51·7 metres of circumference; which corresponding to

TABLE No. III.—NUMBER OF HORSES REQUIRED TO OBTAIN A SPEED OF TWELVE KNOTS.

	Displacement.	Fictitious surface expressed by 2/3. displacement.	Surface of midship section.	Proportion between preceding surfaces.	Nominal power.	Power in horses of 75 kilogrammetres.	Number of horses per ton of displacement.	Number of horses per square metre of midship section.	Speed in knots.	Number of horses necessary to transport one ton displacement to one mile with a speed of 12 knots.	Number of horses necessary to propel one square metre of midship section with a speed of 12 knots.	Means.
	tons.		square met.							(2)	(2)	
Bretagne	6800	347	119,5	2,917	1200	2407	0,376	20,14	11,80	0,3955	21,20	
Algeziras	5120	297	99,0	3,000	950	2168	0,422	21,84	12,20	0,4015	20,80	
,,	,,	,,	,,	,,	,,	2361	0,455	23,84	11,85	0,4726	24,76	24,60
,,	,,	,,	,,	,,	,,	1714	0,334	11,31	11,00	0,4336	28,34	
Arcole	5050	294,4	99,0	2,973	950	1725	0,341	17,42	10,17	0,5603	28,58	27,38
,,	,,	,,	,,	,,	,,	1996	0,393	20,16	11,00	0,5103	26,18	
Eylau	5023	293,7	98,7	2,874	800	2383	0,474	23,94	12,01	0,474	23,94	24,45
,,	,,	,,	,,	,,	,,	2445	0,486	24,97	12,00	0,489	24,97	
Souverain	4440	270,2	105,0	2,573	600	1648	0,373	15,70	10,52	0,5539	23,31	
Imperatrice	3796	243,4	68,47	3,554	800	1950	0,514	28,48	11,99	0,514	28,48	
Impetueuse	3784	242,8	69,8	3,478	800	2280	0,602	32,66	11,41	0,700	37,99	
Phlegeton	1452	128,2	38,5	3,070	400	1038	0,714	26,96	11,75	0,761	31,93	
Ariel	225	36,99	9,53	3,882	120	359	1,595	37,70	12,00	1,551	37,7	
Croiseur	174	31,17	8,08	3,857	80	154	0,884	19,05	9,72	1,664	35,32	

(1) The number of horses of 75 kilogrammetre, on the piston, is taken from experiments with the speeds differing but little from 12 knots. When different, it has been calculated how many horses per square metre of midship section were wanted for 12 knots; but it must be observed that, except the *Croiseur*, all other ships get at least 12 knots.

(2) The results of these two columns have been calculated for 12 knots, and have no relation with the speed inscribed on the preceding one.

TABLE No. III., *bis*.—NUMBER OF HORSES OF 75 KILOGRAMMETRES NECESSARY FOR DIFFERENT SPEEDS.

	Speed in knots.	Number of horses of 75 kilogrammetres.	Speed in knots.	Number of horses of 75 kilogrammetres.	Speed in knots.	Number of horses of 75 kilogrammetres.	Speed in knots.	Number of horses of 75 kilogrammetres.	Speed in knots.	Number of horses of 75 kilogrammetres.	Speed in knots.	Number of horses of 75 kilogrammetres.	Speed in knots.	Number of horses of 75 kilogrammetres.
Bretagne	8,4	1070	11,2	2148	11,54	3568	,,	,,	,,	,,	,,	,,	,,	,,
Eylau	10,60	1231	11,23	2115	12,00	2445	12,10	2383	,,	,,	,,	,,	,,	,,
Souverain	9,13	873	9,50	1490	9,57	1350	9,74	1383	9,95	1646	10,37	1587	10,50	1648
Algéziras	9,80	1109	10,32	1521	11,0	1714	11,21	2335	10,92	1604	11,85	2361	12,20	2153
	11,85	2361	12,69	2456	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
Arcole	9,27	1665	9,80	1227	10,17	1725	10,89	2028	,,	,,	,,	,,	,,	,,
Impératrice	7,99	570	7,14	466	10,71	1233	10,72	1764	11,18	1247	11,67	1775	11,74	1663
	11,99	1951	11,93	2121	12,05	1896	12,06	1977	12,07	1941	12,25	2092	,,	,,
Impétueuse	7,14	597,6	7,79	714	8,17	634	10,02	1709	11,07	1740	11,41	2260	,,	,,
Phlégéton	10,5	614	11,75	1038	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
Isly	7,85	467	9,63	788	12,09	1375	,,	,,	,,	,,	,,	,,	,,	,,

TABLE No. V.—PADDLE STEAMERS OF IMPERIAL NAVY.
ECONOMICAL EFFICIENCIES DURING THE YEARS 1852, 1853, AND 1854.

Nominal power of engines.	NAMES OF SHIPS.	Number of ships of each kind.	Mean length.	Mean beam.	Mean displacement.	Mean midship section.	Mean speed.	Coal burnt during 1 hour.	ECONOMICAL EFFICIENCY. To the midship section. $\frac{V_3 \times B_2}{\text{Coal.}}$	To midship section and corrected. $\frac{V_3 \times B_2}{\text{Coal} \times b}$	To displacement $\frac{2}{3}$. $\frac{V_2 \times D^{\frac{2}{3}}}{\text{Coal.}}$	Relative. $\frac{V_3 \times D^{\frac{2}{3}}}{\text{Coal} \times b.}$	To displacement. $\frac{V_3 \times D}{\text{Coal.}}$	COAL BURNT. To travel 1 mile.	To transport 1 ton of displacement 1 mile. At the speed of 8th column.	To transport 1 ton of displacement 1 mile. At a speed of 10 knots.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
			m.	m.	tons.	sq. met.	knots.	kil.						kil.	kil.	kil.
540	*Descartes*	1	70,14	12,40	3 023	55,86	7 ,73	2 268	11,38	0,909	48,9	4,00	615,8	293,4	0,097	0,210
650	*Mogador*	1	70,96	12,20	2 736	51,68	9 ,20	2 307	17,45	1,430	52,46	4,30	925,9	250,7	0,091	0,117
450	*Asmodée, Gomer, Labrador, Magellan, Orénoque, Montézuma, Eldorado, Sané, Albatros, Canada, Christophe Colomb*	11	69,60	12,00	2 605	51,28	7,518	1 550	14,06	1,171	52,64	4,38	710,5	206,20	0,079	0,186
220	*Véloce, Archimède, Caméléon, Gassendi, Pluton, Espadon, Caiman, Cassini*	7	58,05	9,00	1 279	29,31	5 ,68	883	6,08	0,575	29,28	3,25	276,9	156,05	0,121	0,660
200	*Eclaireur, Phœnix, Mouette, Héron, Milan, Brandon, Dauphin*	7	49,00	8,10	569	16,50	7,833	913	8,41	1,038	34,23	4,22	289,3	120,4	0,211	0,439
160	*Crocodile, Météore, Chimère, Fulton, Cerbère, Tartare, Achéron, Tonnerre, Grégeois, Grondeur, Euphrate*	11	46,20	8,00	777	21,55	5,474	687	5,15	0,644	22,206	2,77	212,5	125,50	0,161	0,931
120	*Vedette, Flambart*	2	42,00	6,55	357	12,45	5,680	600	3,80	0,595	20,75	3,17	150,6	105,60	0,212	1,157
100	*Averne, Voyageur*	2	40,45	6,18	286	,,	6,220	105	,,	,,	33,73	5,45	197,7	59,53	0,209	0,869

The details of calculations whose means are inscribed here are to be found in the "Treatise on the Screw Propeller."

the 16 strokes of the nominal power, makes 26·7 miles per hour. But as the surface of paddle is rather small for such a mass (nearly 1-20th of midship section), the ship will be probably 15 per cent., notwithstanding the powerful help of the screw and with 16 strokes, the ship would go at a rate of 21·9 knots.

On looking at the formula of *relative utilisation* some would have been struck to see displacement $\frac{2}{3}$; that is to say a surface divided by a line, as the beam is. It would appear that the result should be a line. If the bottoms of ships were regular and similar solids, this would be true for admitting a cube of 10 metres on the side, viz., 1,000 metres of volume, taking the root $\frac{2}{3}$, viz., 100 square metres of surface, and dividing by 10 the result is 10, which is the side. It would appear more natural to give this simpler form $\frac{V^3 \times 6}{\text{coal}}$. But the bottom of a ship is far from a regular solid, and it would be very erroneous to adopt such a mode of calculation.

They can say also, that witbout adopting such a simplification it would have been right to divide by the cube root of displacement instead of the beam; but then the ship would have been apparently shortened, and the long one would have lost the advantage we have demonstrated before. As a proof, let us take again the example of the two men-of-war we have spoken of, and let us put 1 for the beam as well as the displacement of the smaller, we shall have $\sqrt[3]{1}$ and $\sqrt[3]{2}$, or 1·26; that is to say that the real beam being 16·20 metres the theoretic would be 20·41 metres, or $\frac{1}{4}$ more than reality. The division of the result by this number would be too disadvantageous to the long ship. These calculations have been executed by the author. They have given a new proof of the preference to be given to the proposed method, which, under the simplest form, keeps the best account of all qualities and proportions of a steam-ship. (Plate III.).

There is, however, another formula, which, according to the principles established, gives a means of better calculating the peculiar qualities of the steam engine and its propeller. It is to take the economical utilisation according to the midship section; that is to say, the cost of overcoming the resistance to the propulsion, and to divide it by the beam, as has been done in the beginning, for the *theoretical utilisation.* These kind of calculations have been put in a Table, and their results are shown on Plate III. by an asterisk.

On looking at these numbers, it is to be remarked how great are the differences in the result of engines and propellers, as the fuel is made useful in the extreme proportions of 3·48 to 0·50—that is to say, they are engines doing *seven times* more work than the worst. The uncertainty of observations do not permit the adoption of such results as certain, but they show the immense differences in the work of engines according to their first making, the care taken of them, and their efficient working. They prove, once more, that for steam navigation there is no small economy, and that good engines are as precious as good engineers, and, we may add, intelligent captains. When comparing on the plate or on the tables this kind of utilisation with those calculated with displacement $\frac{2}{3}$, the influences of proportions of length to beam are to be remarked. So the *Roland,* whose utilisation is superior with the midship section, loses her advantages when calculating with displacement $\frac{2}{3}$. She is compared with long packets—as *Hydaspe* and *Jourdain,* of Messageries Imperiales. The form of such a table is certainly the best to compare ships of every dimension, but it takes only the amount of the force expended to overcome an obstacle that is to force the midship section through water, but not the real work in transporting a given weight: each of these methods has its own value.

If to all these combinations they had added the weight of coal necessary to force a metre of midship section through water, some curious comparisons would have been made between long and short ships. But this would have been nearly a repetition of what had been shown on the third Plate.

Admiral Paris employed another manner of counting the utilisation of ships. It has been to calculate, as for railways and every means of transport, what is the cost of a weight carried at a fixed distance. Till now the work done has been compared to the displacement; and it is very easy to establish that the duty is 1 ton displacement to 1 nautical mile, which is done by dividing the coal burnt during one hour by the produce of the displacement by the number of knots. It is evident that such results vary not only according to the square of the speed, but also as to the dimensions of the ship. Such calculation has been made for every speed, and put on a plate, where the disorder of positions was a proof that such a comparison was to be made for the same speed, and the reduction has been made according to the square of knots observed to 100—that is to say, to the square of 10, this number being the speed adopted. The result inscribed on various tables has been collected on the Plate vi., of which the vertical scale shows displacement of every ship, half a millimetre being equal to a ton; and the horizontal scale is for the number of grammes of coal burnt—and half a millimetre is equal to one gramme. The first glance at this plate shows the economy of transport on board of large ships, and to make it more sensible two curves have been traced as two lines on Plate i.—that is, one from the large ship having the best results (*i.e. Algéziras*) to the small ones having the same quality (*i.e. Ariel* and *Faon*), and passing through the points of ships which make good use of their coal; and another of ships of indifferent qualities. It is to be observed for this Plate, as for any others, that coal burnt during trials is designed by a small round, and that crosses are used for navigation.

This Plate is an evident proof of the heavy expenses incurred by bad engines; but instead of being general, as on Plates I. and III., this curve can be used only for ships of the same size. It is seen that *Louis XIV.* and *Fleurus* make good use of their fuel—half of *Algéziras*—and there is a similar difference between the *Fleurus* and *Sovereign;* and this is to be attributed only to the engines, as these two men-of-war are both old models. The *Sevre* presents very advantageous results; and it is not only owing to the engine made by Mr. Moll, but also to her great relative length. When looking down to the small ships, more striking differences are remarked between the results of those of the old construction and those recently made whose engines make a better use of coal. The old paddle sloops-of-war of 220 and 160 H.P. are now, for that reason, a very expensive means of transport, though they are very slow.

The measure of the coal used to perform a transport of 1 ton displacement to 1 mile presents the best manner of comparing ships of the same size, and especially to know the differences which by-and-by happen in the qualities of ships; for engines lose very often a great deal of their propelling force, and often very sensibly produce a loss of speed. Generally the boiler is the cause of the loss; and if such comparisons do not point to the true cause, they have the advantage of awakening attention.

The French author made also some researches into the cost of the acceleration of speed of ships of different sizes. For that purpose he investigated in the results of the working of the French Navy, how much coal had been burnt at various speeds; but as the officers never gave their attention to these questions, they never tried with low speed, and generally they never observed below seven knots; so the inferior point of observation is not as low as would have been proper for good examples. The trials of small ships never give such experiments, except on board of the *Ariel* where the chief engineer had determined exactly the expense of coal at various speeds. The results have been put on Plate VII., on which the vertical scale represents the speed in knots, and the horizontal one the coal burnt to carry 1 ton displacement to one mile; half a millimetre representing 1 gramme of coal. The calculation being made for a distance of a mile, the expense would be in the ratio of the square of the speed, the influence of expansion not being counted, and not of the cube as for absolute speed. From the extreme point of each group to the point zero, curves have been traced in the ratio of the square of speed; and it is to be perceived that they follow almost exactly the various points marking the expense at every speed, and they prove that the increase of expense with the speed is almost the same on board of small as well as of large ships. However, it is probable that little ships require proportionally more force; because the *Ariel* having sharp lines, and six times her beam, is there compared with a man-of-war of coarse lines having no more than four times, and a frigate or corvette of four and five times the beam. Consequently it is to be assumed that even with a calm, small ships are more expensive than large ones, when the speed becomes quicker; and Admiral Paris found a proof of it by a similar curve, traced with the coal burnt to force a square metre through water with different speeds. It is to be wished that numerous experiments of this kind may be made from slow to quick speed, for it is probable that if with their displacement men-of-war were built on lines as sharp as those of packets, they would find the advantage of great dimensions proved by the table of number of horses wanted at different speeds and with various dimensions. To obtain a solution, it would be necessary to know the cost of sharp-built packets like *l'Euphrate, Gange, Thabor,* and *Sinai,* at different speeds. Without that similarity no comparison is exact; and to compare *Ariel* with old men-of-war, is to compare a gazelle with a drayhorse.

This delineation is probably the best to throw some light on the questions of the influence of dimensions on speed, and it will be of great use when new lines of packets are intended. It is supported by facts, and if executed on a large scale and for ships of every dimension, it will present to commercial associations a basis much more secure than any others now in use.

Consequently, it is to be wished that officers, and especially captains, when navigating would record what they consume with different speeds on board of small ships as on board of men-of-war, and all these data committed to paper would present some results that could be depended on.

Here the advantage of good engines is again to be remarked. *Algéziras* and *Eylau* are on the left of *Napoleon,* and, notwithstanding her dimensions, *Bretagne* has her curve on that of *Imperatrice, Arcole,* and *Roland.* So the advantage of large dimensions is lost by indifferent working of the engines.

The facts shown prove how engines of the same nominal power are far from giving equal results, and how many errors would be made if the nominal power were relied on—they would believe that similar vessels of equal power are able to perform the same service. This has been fully proved by the experiment of the squadron in the Mediterranean Sea, and this is a new proof of the immense value of good engines, well kept and wisely directed.

How much the makers of engines must struggle against difficulties to produce equally powerful engines, what better example can be cited than that of the *Algéziras* of M. Dupuy de Lonce, whose 8,000 tons of displacement cost no more for the same speed than the 1,280 tons of the old paddle-corvette of 220 H.P., and the 770 of smaller ones of 160 when these ships are in good circumstances at sea. But if we look at the common service (Plate i. and vi.), those old-built ships burnt double, to travel over the same distance, however they had the chances of the wind, which are more favourable than adverse when good use of the wind is made.

Considering that the expense of force for 1 ton to a mile is in the ratio of the square of the speed, and that the lessening of this one permits us to make a better use of fuel by expansion and moderate firing, it is astonishing to see such an accordance between the curve with full line and the coal burnt with different speeds. For if these two lines were really over each other, or in one, it would be concluded that expansion is not a source of economy in the production of force, or that the resistance of the bottom is not in the ratio of speed, as it had been admitted.

In order to make a verification of this principle, the French author took in the experimental trials the number of horses at 75 kilogrammetres necessary to each ship with various speeds, and the results were put in a similar manner on another plate. And from the extreme group to the point zero a line was traced in the ratio of cubes of speeds. This shows a complete concordance with the former, and the curve passes so well in the middle of points, marking the number of horses, that we can admit practically that the expense of power is practically in the ratio of the cube of speeds. Unfortunately, it is to be regretted that not a small ship has furnished observations of this kind, so as to have a real value; this must be done with the results of a great variety of ships.

The comparison of the positions deduced from the number of horses shows that the engines with two cylinders of the *Algeziras* and *Imperatrice,* as well as the equilibriated cranks of the *Eylau,* present an economy of force in comparison to those with four cylinders—the *Bretagne, Arcole,* and *Impetueuse.* As to the coal, the results are different, and a ship which shows such advantages on the Table 7 is far from being the same with an indicated number of horses. So the *Impetueuse,* which is over for power, is under for the coal;

Table No. VI.—EFFICIENCY OF SAILING SHIPS ACCORDING TO THE SURFACE OF THEIR SAILS, ADMITTING A COMMON SPEED OF EIGHT KNOTS.

Names.	Number of guns.	Length.	Beam.	Proportion.	Displacement.	Surface of sails.	Efficiency. To displacement $\frac{V3 \times D}{\text{surface of sails}}$	Efficiency. To displacement 2/3 $\frac{V3 \times D\ 2/3}{\text{surface of sails}}$	Efficiency. Relative $\frac{V3 \times D\ 2/3}{\text{surface of } S \times b}$	Square metres of canvas necessary to transport one ton displaced, or, surface of sails / displacement.
		m.	m.			sq. met.				m2
Océan, Friedland	120	62,99	16,30	3,881	5 057	3 066	850,3	49,20	3,02	0,606
Tage, Jemappes	100	62,50	16,20	3,857	4 445	3 040	745,5	45,53	2,81	0,683
Breslau, Turenne, Bayard	90	60,72	15,77	3,850	4 058	2 880	721,4	45,23	2,87	0.709
Diademe, Neptune, Suffren	86	60,50	15,75	3,841	3 960	2 829	716,7	45,29	2,87	0,797
Uranie, Iphigenie, Didon	60	53,93	14,13	3,816	2 558	2 582	507,1	37,09	2,79	1,009
Pandore, Nereide, Reine Blanche	52	52,00	13,36	3,892	2 200	2 006	561,0	43,12	3,22	0,911
Thetis, Erigone, Africaine	44	48,00	12,40	3,879	1 707	1 920	455,2	38,09	3,07	1,124
Galatee	30	43,30	11,80	3,670	1 179	1 593	378,9	35,87	3,04	1,351
Heroine, Berceau	30	42,00	10,70	3,925	1 015	1 450	358,4	35,74	3,34	1,428
Naiade, Triomphante, Danaide	30	38,21	9,70	3,938	751	1 264	304,2	33,47	3,45	1,683
Hussard, Adonis, Alcibiade	20	33,68	9,00	3,631	550	1 112	253,3	30,91	3,43	2,020
Genie, Mercure, Faune	18	33,70	9,10	3,70	540	1 139	277,8	32,63	3,58	2,110
Alcyone	10	24,44	6,39	3,82	188	873	110,2	19,25	3,02	4,643
Alsacienne	8	25,06	6,40	3,91	165	765	110,3	20,12	3,14	4,636
Estafette	,,	18,46	5,05	3.65	108	547	100.8	21.23	4,20	5,064
								Mean =	3,18	

Table No. IX.—MEAN RESULTS OF THE SERVICE OF MESSAGERIES IMPERIALES DURING THE YEARS 1852, 1853, AND 1854, MARKED M′ ON THE PLATES.

Nominal power. 1.	Names of ships. 2.	Number of ships of each kind. 3.	Length. 4.	Beam. 5.	Displacement. 6.	Midship section. 7.	Mean speed. 8.	Coal burnt during 1 hour. 9.	Economical efficiency. To the midship section. $\frac{V^3 \times B^2}{\text{coal}}$ 10.	Economical efficiency. Relative $\frac{V^3 \times B^2}{\text{coal} \times b}$ 11.	Economical efficiency. To displacement ⅔ $\frac{V^3 \times D^{2/3}}{\text{coal}}$ 12.	Economical efficiency. Relative $\frac{V^3 \times D^{2/3}}{\text{coal} \times b}$ 13.	Economical efficiency. To displacement $\frac{V^3 \times D}{\text{coal}}$ 14.	Coal burnt. To travel 1 mile. 15.	Coal burnt. To transport 1 ton displacement at 1 mile distance. With the speed of the 8th column. 16.	Coal burnt. To transport 1 ton displacement at 1 mile distance. With a speed of 10 knots. 17.
			m.	m.	tons.	sq. met.	knots.	kil.						kil.	kil.	kil.
300 to 350	*Euphrate, Gange, Indus*	3	79,80	10,96	2 714	53,32	9,91	1 618	32,08	2,926	117,50	10,63	1633,0	162,5	0,060	0,062
320	*Thabor, Sinai*	2	60,00	8,77	1 121	29,18	10,81	1 531	24,53	2,797	89,40	10,19	942,0	150,3	0,134	0,106
220	*Osiris, Egyptus, Alexandre, Caire, Nil, Louqsor*	6	54,40	9,24	1 031	27,72	8,91	1 070	18,33	1,983	64,35	6,96	681,8	125,7	0,122	0,172
180	*Mérovée, Hellespont, Oronte, Bosphore, Philippe-Auguste*	5	50,80	6,95	571	17,17	8,94	939	13,06	1,879	54,65	7,86	434,3	110,0	0,192	0,269
160	*Léonidas, Lycurgue, Tancrède, Scamandre, Mentor, Télémaque, Aventin, Eurotas*	8	50,00	8,00	771	20,49	7,61	830	9,39	1,174	46,04	5,75	402,0	113,0	0,149	0,338
120	*Périclès, Pharamond*	2	48,50	6,62	374	11,92	9,03	698	12.58	1,900	53,52	8,09	394,6	86,7	0,232	0,315

The details for each of these ships, whose general means are inscribed here, are to be found in the "Treatise on the Screw Propeller."

Table No. X.—MEAN RESULTS OF THE SERVICE OF MESSAGERIES IMPERIALES DURING THE YEARS 1854, 1855, AND 1856, MARKED M′ ON THE PLATES.

Nominal power. 1.	Names of ships. 2.	Number of ships of each kind. 3.	Length. 4.	Beam. 5.	Displacement. 6.	Midship section. 7.	Mean speed. 8.	Coal burnt during one hour. 9.	Economical efficiency. To the midship section. $\frac{V^3 \times B^2}{\text{coal}}$ 10.	Economical efficiency. Relative $\frac{V^3 \times B^2}{\text{coal} \times b}$ 11.	Economical efficiency. To displacement ⅔ $\frac{V^3 \times D^{2/3}}{\text{coal}}$ 12.	Economical efficiency. Relative $\frac{V^3 \times D^{2/3}}{\text{coal} \times b}$ 13.	Economical efficiency. To displacement $\frac{V^3 \times D}{\text{coal}}$ 14.	Coal burnt. To travel 1 mile. 15.	Coal burnt. To transport 1 ton displacement at 1 mile distance. With the speed of the 8th column. 16.	Coal burnt. To transport 1 ton displacement at 1 mile distance. With a speed of 10 knots. 17.
H.P.					tons.		knots.	kil.						kil.	kil.	kil.
300 to 350	*Euphrate, Gange, Sinai*	3	79,80	10,96	2 714	53,32	9,96	1 665	23,81	2,17	73,70	6,72	1 062	182	0,077	0,104
240 to 370	*Cydnus, Simois, Mersey, Borysthène Hydaspe, Carmel, Danube*	11	66,6	9,51	1 496	32,99	9,30	1 415	21,54	2,26	75,19	7,90	836	153	0,108	0,132
,,	*Chéliff, Mitidjah*	2	66,42	7,03	1 175	28,2	7,91	910	15,34	2,18	61,05	8,68	645	126	0,107	0,211
220	*Alexandre, Caire. Egyptus, Nil, Louqsor, Osiris*	6	54,40	9,24	1 031	27,72	8,29	1 124	14,06	1,52	51,45	5,56	516	135	0,133	0,234
160	*Léonidas, Lycurgue, Aventin. Mentor, Télémaque, Scamandre*	7	50,00	8,00	771	20,49	7,36	859	8,12	1,01	38,96	4,87	359	108	0,158	0,396
180	*Bosphore, Hellespont, Mérovée, Oronte, Philippe-Auguste*	5	50,80	6,95	571	17,17	8,776	944	12,30	1,78	51,59	7,42	397	109	0,189	0,279
120	*Pharamond, Périclés*	2	48,50	5,62	374	11,92	8,025	654	9,42	1,42	39,43	5,95	298	81	0,255	0,415

and the *Algéziras*, which is mingled amongst others in the second case, is separated on the plate according to her economy of fuel.

At least, Admiral Paris searched to find the variations of *economical utilisation* according to the speed, and, taking necessary data on his various tables, he formed a plate with speed in ordinates, and utilisation in Plate IX., not only for midship sections, but also for displacement $\frac{2}{3}$ and displacement. If the results had not been influenced by wind, or by an increase of resistance greater than the square of the speed, they would have been on a straight line parallel to the ordinates, which is not the case except for the *Napoleon* and *Ariel*.

Here is found again the influence of the dimensions of ships, as the *Ariel*, though having a beautiful *relative utilisation* is everywhere on the left of all others. It is also to be remarked that the *Sovereign*, which has a good utilisation with the midship section, is losing this advantage with displacement $\frac{2}{3}$, so much that she is on the right in the first case, and on the left in the second.

Some of the points have been taken when a favourable or adverse wind was blowing, and they show how great is the influence of wind on the *economical utilisation*, and that unfortunately it is only with fair weather and a smooth sea that comparisons can be made, because the obstacles of wind and swell cannot be measured. Few useful instructions are to be found in this last manner of considering the economical utilisation, because the ships were not working together against the same adverse swell and wind.

But how many precious instructions would be found if several ships of various forms were compared against the wind, and if thrown in the road of Hyéres against a fresh north-wester, they pass from the smooth water of this extensive road to the hard and short swell from these islands to Marseilles. The powerful engines would gain in the scarcely ruffled water of the road, because they would not feel so much the influence of forms and of positions of weights, but when exposed to the swell the sharp bows would gain the full head in spite of their powerful engines. An old man-of-war lost in such a case from 9·8 knots to 1·8, and during some time she was completely stopped though the wind was the same when inside and outside. Other ships working heavily against the swell had 50, 60, and even 68 per cent. of slip. Careful experiments are wanted on this subject, and as the obstacles of wind and sea cannot be measured, it is to be wished that comparative experiments would be made against the so frequent difficulties of the sea.

There was naturally some interest to know if *theoretical utilisations* would not show some curious facts, and for that reason the French author cites all those he collected, in the same way as for economical utilisations, but he would not deduce any law.

At least he acted in the same manner for sailing ships, and considering the surface of canvas as the expression of the moving power, he calculated how many square metres of sail would carry a ton of displacement to 1 mile distance and at 8 miles speed, and what were the utilisation with the midship section, the displacement $\frac{2}{3}$, and displacement as for steaming ships; the curves were nearly the same; but what proved the truth of what has been established for *economical relative utilisation*, has been the result of the same method for sailing ships whose results on marking $\frac{V\ 2\ D\ \frac{2}{3}}{\text{surface of sail} \times \text{beam}}$ had been quite a straight line, parallel to the ordinates, showing that the same law holds good for sailing as for steaming ships, and that it can be adapted to the best standard.

The administration of Messageries Impériales lately made a very interesting application of the ideas emitted by Admiral Paris in 1855, when he published a translation of the "Treatise on the Screw Propeller," by Mr. Bourne, followed by practical observation, descriptions of new screw engines, and tables of utilisation. M. Delacour, engineer of the Company, and director of the Company's dockyard at La Ciotat, took the results of speed and coal burnt by every packet during three years, or less for steamers whose flue boilers were changed for tubular ones. He made after that a formula, and gave to each ship a *co-efficient of performance*, which has been the basis for calculating the economies made by each ship during the year 1857, of which economies a part has been given to the captain and to the chief engineer of each packet. The result has been an economy of nearly 10 per cent. on the coal, according to the three years taken by these means as the point of comparison, and for the year (1858) it will probably be more, because the case is better understood by the generality of captains and engineers. It was the act of a right and generous mind when Mr. Baker, director of the navigation service of the Company, gave to the author of the work the data of all his service.

How many instructive hints would be deduced if all steam companies would publish periodically, and with the same truth and exactness, the results of their packets! As the French Author says, the steam navigation companies have not generally the same concurrence between themselves as other industries. What rivalry there is between the Cunard Line and the Peninsular and Oriental Company! Some small ones are at times playing close to the large, but they have never the same mode of acting and the same purposes as miners, who are working close to each other, and all to extract coal from the deep shaft. However, they have founded the *Cornish Association*, which, looking to the practical point, and making no abstract theory, established that the best engine is that which hoists most for least coal burnt. If, then, the duty is easy to measure, and can be exactly appreciated at every moment, because the condition of their engines never varies, it is not a reason why the uncertainty of weather and winds, and even of qualities of ships, should be an obstacle to do the same for steam navigation. But there, instead of counting during a short period, it is necessary to take a long one—the year—and, by and by, several years, to cross in every direction the chances of sea and wind. Navigation is not perfect enough to give to such data less chances of errors than the study of winds and currents. However, Captain Maury has collected so many log-books, and made what Daprès de Mannevillette and Horsburgh did at a time for some seas, and he did it on so large a scale that useful instructions shall rise from this remarkable re-union of facts.

Why, then, could not a *steam navigation economical society* be founded, like a wind and currents one, or like the Cornish Association, and the Societé de Mulhouse? If the data collected were less exact than those in the mines, or of workshops, how superior they would be to those on the winds, and especially on currents, which, though much more important, are observed at sea by so coarse a mean—the difference between the log-book and the altitudes taken at different hours. But some will say, perhaps, that the pride of a captain is not at all engaged if he encountered head wind and heavy sea, and then he will deliver exactly what he observed and marked on his log-book. But all seamen are fond of their own ship—they are not pleased to hear her badly spoken of, and it hurts their pride to confess that their navigation has not been successful; it is natural, because the captain has a great influence on the results, and the engineer also in his own quarter. Truth would be perhaps difficult to know in that way. But for the owners it is not the same; and this part of the management of affairs not being their own, they can better publish it, and with a sufficient exactness, as they know the coal burnt, and the hours of arrival and departure; that is all that is wanted, when for the first time, the dimensions of the ship, and especially her displacement at different draughts, and each draught is known.

For the application of these useful ideas, Admiral Paris concludes by the means of making the applications of what he tried to prove, and the result of his work is as follows:—As economical qualities of ships can never be measured in the same manner, whatever may be their dimensions, it is possible to establish direct comparisons, whose utility is demonstrated by observations of the same kind made on shore.

An adoption of a general measure, at least in the Imperial Navy, is much to be desired, and to see it extended afterwards to every company, in order to obtain for steam navigation results as those of Captain Maury's 'Wind and Current Charts,' which results would be as useful, and probably much more certain.

An association founded for that purpose, would do more service *than theoretical studies*, it would enable us to weigh the relative merits of all constructious; and as the packets employed on lines of service do not generally make any concurrence to each other, such as establishments working close to each other, and mines, the publication of exact results of the speed, and coal burnt, would throw light open to every one without producing prejudicial rivalries.

It would be necessary to establish the economy of fuel as the chief condition of bargains for new engines, that the quantity of coal burnt would be stipulated for an introduction of steam and a number of strokes according to the power. That the measures taken of the fuel would last long, to divide more the errors of the beginning and the end of observations; at least, some money would be deducted from the maker of the engine in case of too much coal burnt; and also a price (called in France *une prime*) would be paid according to the economy. This expense would be very soon paid back and the service of ships would be secured. Such means extended to the lubrication, that is the quantity of oil and tallow, would diminish the expenses and the dirtiness of the hold.

The commissioners of receipt for the government engines would be ordered to measure the fuel as exactly as they do the power by means of the indicator. They should act not only at full power, but also with slow working to study some important laws, and determine the true profits of working expansively. They should indicate atheorigin and quality of fuel and the number of furnaces deducted, that is to say shut, as a guarantee of the production of steam during the future service. Their observations would be collected, according to the principles preceding, by established form, and would present the various *conomical utilisation*, the value of a ton of displacement transported to one miledistance, and the number of grammes necessary to force one metre of midship section through the water. These data would be after calculated for a common speed of 10 knots. The commissioners would be ordered to determine the coefficients at different grades of expansion and during a calm. The experiments should last long, and the distance used as the base for speed should be long also; a measured mile has no value, but the distance from Toulon to Corsica, Minorca or Algiers. The index of economical qualities of the ship would be inscribed at the beginning of the ministerial report of steam-ship navigation. At least, when experiments have been made against a heavy swell this would be mentioned with the loss of speed, and utilisations observed under unfavourable circumstances.

The reports would mention all that occurs, and they would calculate the utilisations and especially the value of the ton transported, as well as that of the square metre forced. The observations made with fresh breezes or heavy sea would be always separated from those made during a calm and smooth sea, because these permit exact comparisons with other ships. The difference between the type-coefficients of trials and those observed after would be explained, and their causes investigated in order to discover a remedy. At least to insure as much as possible the exactness of observations, it would be necessary to record the quantity of coal on board at the beginning and at the end of each period of report, and to have these quantities controlled as well as receipts and expenditure by the purser of the ship and the authority on shore.

Admiral Paris suggests that to obtain useful comparisons, it would be necessary to give the chief data of the construction of the ship, as length,* beam, depth, draft of water, mean displacement at sea, midship section at the usual draft, its position according to its length, angle of fore-water-line at water-level and at the height of the gunwale, surface of sails, &c. For the engine: principal dimensions, number of strokes, pressure of the steam-force *in gauge-horses*, proportions of the propeller, number of revolutions, heating surface, grate surface, and funnel section. For the sea service; speed by log, or according to the line of direct track on the map, mean slip, consumption of coal, its origin and quality, details of the state of the bottom, circumstances

* For the length, that taken at the water-level and from cutwater to stern-post is more useful than over all.

of navigation which had an influence on the means calculated, curious facts observed, and details on the results against wind and sea, in order to compare with other ships.

The economical utilisations should be calculated with these data, as well as the expense of coal to transport one ton of displacement a mile, reduced to the common speed of 10 knots; and each captain or owner seeing the results of his ship compared with those of other companies, would be exerted to acquire new qualities or keep well those he possesses,—because ships and their engines are losing a great deal of their qualities, and it is the knowledge of the loss which would very often excite and compel them to search for the remedy. In short, it would be on the sea as is done in Cornwall, and though the sea questions are more complicated, their investigation would not be less profitable.

We regret that it is not possible, for the present, to afford more space for citations from Admiral Paris's very admirable volume; but we hope to be able, at an early date, to enter again upon the task. In the meantime we believe that every one who takes an interest in the important question of steam-ship economy, and can read French, will refer to the work itself, which is published by M. Arthus Bertrand, of Paris, and may, no doubt, be had of any of the foreign booksellers in London.

EXTRACT FROM "THE OVERLAND COMMERCIAL GAZETTE,"

Port Louis, Mauritius, 27th *Dec.*, 1858.

We have much satisfaction in announcing, that to facilitate the recently-established mail service between this port (Australia) and the mother country, the Mauritius Dock Company have commenced the excavations for a vast dry dock, to afford every facility for repairing such noble vessels as we shall shortly have calling at our port (Port Louis). The size of the dock is to be 350 ft. long, 80 ft. extreme breadth, 60 ft. mean, and 40 ft. minimum breadth; depth, 22 ft.; in fact, capable of easily taking in such magnificent vessels as the *Duke of Wellington*, of 3,756 tons; length, 278 ft.; length of keel for tonnage, 202 ft.; depth of hold, 24 ft.; breadth, 62 ft: her Majesty's steam-frigate *Mersey*; length, 336½ ft.; length of keel for tonnage, 254 ft; breadth, 52 ft.; burthen, 3,726 tons. Her Majesty's ship *Boscawen*, which was lately here, is 2,212 tons; length, 213 ft. Such a vessel would appear like a longboat in the new dock. The most important fact is, that merchant ships of all sizes can be taken into dock, and immediately repaired.

The pumping machinery is being constructed by Messrs. Gwynne and Co., engineers, London, whose names stand so favourably before the public. Engines of 100 H.P. will work three centrifugal pumps each, discharging 12,000 gallons of water per minute; and the dock, when full, containing 13,000 tons of water, will be entirely emptied in 2½ hours.

Besides these pumps, a smaller one, worked by a separate engine, will keep the dock dry during repairs to vessels.

The Company have in addition a forge, and every appliance for the repairs of iron vessels. This fact cannot be too widely known.

The contractors have engaged to finish the excavations in a year; but nine months will probably suffice for the reception of vessels.

THE ASSOCIATION OF FOREMEN ENGINEERS.—ELECTION OF CHAIRMAN.

The Associated Foremen Engineers held a meeting at the Bay Tree Assembly Rooms, City, on the 5th ult., principally for the election of a President in the place of Mr. Sheaves, whose demise was noticed in our last. Mr. Joseph Newton having been proposed by Mr. Keyte, and seconded by Mr. Ross, he was unanimously elected.

Mr. Newton, in thanking his fellow-members for the spontaneous favour conferred on him, took occasion to remark upon the sterling character of his predecessor, and to express a hope that he himself might be enabled to walk worthily in his footsteps. The President elect, in further speaking of the very hopeful position in which the Society stood with regard to the mechanical community generally, and its prospects of extended usefulness to the particular class from whom its members are drawn, incited all to increasing activity in furthering its interests and their own intellectual advancement. Those who had not hitherto prepared Papers for the monthly discussions *must* now, he said, commence to do so. They need not stand upon the niceties of composition; the *manner* would not be criticised so long as the *matter* was good. Foremen engineers should become as useful in their own institution as they were in their workshops. Each one knew something which his neighbours knew not, and individual exchange of ideas resulted in general improvement and enlightenment. Mr. Newton himself promised a Paper for the next meeting, which would be held at the same place and time (8 p.m.), on the first Saturday in March, the subject being the "Influenee of Mechanical Science and Mechanical Men on the Age in which we Live."

Later in the evening considerable solicitude was expressed on account of Mrs. Sheaves, relict of the late President, and her infant family of four sons, and it was thought that if the fact that unfortunately no provision had been made for them were published, some kindred spirits might thereby be induced to come to the rescue. There are, no doubt, many individuals connected with the various branches of the engineering profession who, though having sufficient for the day, are unable to make provision for the future, and the more especially when Fate is sudden in its decrees. To the affluent and the charitable, of whatever sect or profession, it may be said that assistance in this case will be of great value, and is painfully needed.

Mr. Henry Grissell, of the Regent's Canal Iron Works, City-road, London, has kindly consented to act as treasurer for the widow and orphans, and he will gratefully acknowledge any and every contribution, large or small, on their behalf.

ON THE ELECTRIC CONDUCTING POWER OF THE METALS.*

By Augustus Matthiessen, Ph.D.

The following values for the conducting power of the metals were determined in the Physical Laboratory at Heidelberg, under the direction of Professor Kirchhoff, by the same method as is described in the "Philosophical Magazine," February, 1857.

	Conducting Power	at Temp. in Celsius's degrees.
	°	°
Silver	100	0
Copper, No. 3	77·43	18·8
Copper, No. 2	72·06	22·6
Gold	55·19	21·8
Sodium	37·43	21·7
Aluminium	33·76	19·6
Copper, No. 1	30·63	24·2
Zinc	27·39	17·6
Magnesium	25·47	17·0
Calcium	22·14	16·8
Cadmium	22·10	18·8
Potassium	20·85	20·4
Lithium	19·00	20·0
Iron	14·44	20·4
Palladium	12·64	17·2
Tin	11·45	21·0
Platinum	10·53	20·7
Lead	7·77	17·3
Argentine	7·67	18·7
Strontium	6·71	20·0
Antimony	4·29	18·7
Mercury	1·63	22·8
Bismuth	1·19	13·8
Alloy of Bismuth, 32 parts; Antimony, 1 part	0·884	24·0
Alloy of Bismuth, 12 parts; Tin, 1 part	0·519	22·0
Alloy of Antimony 2 parts, Zinc 1 part	0·413	25·0
Graphite, No. 1	0·0693	22·0
Graphite, No. 2	0·0436	22·0
Gas-coke	0·0386	25·0
Graphite, No. 3	0·00395	22·0
Bunsen's Battery-Coke	0·00246	26·2
Tellurium	0·000777	19·6
Red Phosphorus	0·00000123	24·0

All the metals were the same as those used for my thermo-electric experiments, with the exception of cadmium, which was purified by my friend, Mr. B. Jegel.

THE BAROMETER AS AN ENGINEERING INSTRUMENT.

By John M. Richardson, B.S.†

(*Continued from page* 36.)

Thus far the results given by the level have been regarded as absolutely correct, and those obtained by the barometer as subject to error. But, after the comparisons which have been made, the question very naturally arises, which instrument gives the most reliable results? The question cannot be decidedly answered at present. Theoretically, both the instruments give correct results, but each is subject to numerous errors. The chief sources of error in the case of the level are—(1) construction; (2) adjustment; (3) observation; (4) refraction; (5) dewpoint, as affecting refraction; (6) unequal expansion and contraction of the parts of the instrument; (7) curvature of the earth.

The errors arising from 1, 2, and 3, can be reduced to their minimum by careful selection, adjustment, and observation; those arising from 4, 5, 6, cannot perhaps, in practice, be avoided; that produced by 7 can be partially corrected. The principal causes of error in the use of the barometer are eight—viz., (1) construction; (2) adjustment; (3) observation; (4) dewpoint, as affecting pressure of atmosphere; (5) unequal expansion and contraction of parts of instrument; (6) changes of temperature, as affecting pressure of atmosphere; (7) agitation of the upper strata of the atmosphere, currents, &c.; (8) daily variation.

Errors arising from 1, 2, 3, as in the case of the level, can be reduced to their minimum by careful selection, adjustment, and observation; those arising from most of the others can be corrected, but they are usually small; and, regarding the barometer as an engineering instrument, they would not perhaps be corrected, except the one due to changes of temperature.

The adjustment of the level is a complex and tedious operation, and requires so much time that it cannot be done before every observation. Hence an error of adjustment may exist for some time before it is discovered. The adjustment of the mercurial barometer is simple, requires but a moment, and has to be made before each observation. The liability to error of adjustment in the case of the barometer, is not so great, then, as

* From the Lond., Edin., and Dub. Phil. Mag., Sept., 1858.

† Extracted from the "Journal of the Franklin Institute."

in the case of the level; but an error of adjustment of the former, although small, will probably cause a much greater error in the determination of differences of altitude, than an error of adjustment of the latter.

An error of observation with the level will usually vary the result but little; but, as a very small change in the height of the mercurial column corresponds to a considerable difference of level, a slight error of observation with the barometer may introduce a very material error in the final result. Upon the whole, then, taking into consideration the other errors, as well as those to which allusion has been particularly made, the liability to error on the part of the level appears to be less than on the part of the barometer. Everything, however, will depend upon the care and skill of the observer; care in avoiding errors, and skill in eliminating those which cannot be avoided.

From this view of the relative liability to error on the part of the two instruments, and the examination of observations made with them, it follows, that although the level is probably the most correct, yet the barometer, when carefully used, will be a valuable auxiliary to the engineering profession.

It is to be hoped, however, that more comparative observations will be made with the two instruments, and it is respectfully suggested to scientific gentlemen who may visit Black Monntain, or who may have opportunity to do so at any other mountain, to run carefully a line of levels from the foot to the summit, driving a stake at every station corresponding to a change of level of 50 or 100 feet, and at every station so determined, to make careful barometric observations. The results thus obtained would probably be of great value, and would determine whether or not *the barometer differences of altitude are too great within certain limits, and too small within others.* Some of the results of the observations quoted from the report of Lieutenant W., appear to indicate the possibility of this being the case; if it is, and extended observations can alone determine it, the limits between which the barometer-altitudes are too great or too small, can, and should, be determined.

This paper has grown under the hands of the writer into a length much greater than he anticipated when he commenced it; and the subject will be dismissed, after making some general observations upon the method of conducting a barometric survey, and giving a few formulas, tables, &c.

According to Biot and others, in order to determine the difference of level of two stations by means of the barometer, *simultaneous observations* should be made at them; but this does not appear to be strictly necessary; for, besides the trouble and expense of having two sets of instruments and two observers, if the stations are sufficiently near for the same atmospheric conditions to prevail at them, they will hardly change during the time required for an observer to record his observations at one and pass to the other. If the stations are too far apart for the same atmospheric conditions to prevail at them, it is evidently unnecessary for the observations to be simultaneous.

How far, north and south, east and west, do the same atmospheric conditions prevail? Has observation determined it? It is believed not. Here is a fruitful and valuable field for investigation. If two stations are separated by a considerable distance, and particularly if rivers, swamps, forests, chains of hills, mountains intervene, it appears to be very improbable that the same atmospheric conditions, temperature, amount of moisture, clouds, winds, &c., &c., should prevail at them; and in order to apply the correction for horary variation, it is only necessary to know the time of each observation.

In making a survey, however, it will be best to compare only those observations which have been made under pretty much the same atmospheric conditions. Thus, although it might do to compare together those observations made on a cloudy, or a windy, or a fair and still day, it would not do so well, perhaps, to compare those made on a cloudy day with those on a fair day; or those made on a windy with those on a still day, &c. Hence, having concluded the survey for one day, the survey for the next day should commence at the last station of the previous day's survey. Connecting the different days' work together in this manner, the final result, or difference of level of the two extremities, as determined by this chain of observations, should agree essentially with the result obtained by comparing together the independent observations made at the two extremities. Thus the barometer furnishes a check upon the observations made with it at intermediate stations.

It is advisable that barometrical surveys should be made during fair and calm days only; and as the observations require but little time comparatively, and as they need be taken only where there are considerable changes of level, an engineer can so select his time as to execute the survey in good weather.

Travellers usually employ the "Mountain Barometer" (mercurial) for the determination of the altitudes of mountains, and for engineering purposes it is perhaps the best also. But the "Aneroid" is so portable and convenient, and requires such little time for making observations, that on these aeeounts it is preferable to the mercurial. The difference between the two is at most but little, and the "Aneroid" is constantly approaching nearer and nearer to perfection. As bearing upon the relative accuracy of the mercurial and Aneroid barometers, the following mean result of fifty-six comparative and simultaneous observations made upon them by Belville, of the Royal Observatory, Greenwich, England, is given:—Mercurial, 29·61; Aneroid, 29·59.

Twenty of the observations agreed exactly. The greatest difference was ·03, and it occurred only three times.

Formulas and Tables.

(1.) From Williams's "Practical Geodesy."

Let h = difference of level of two stations; M and m the barometer-readings at lower and upper stations; T and T′ attached, t and t' detached thermometer at lower and upper stations; then,

$$h = 68{\cdot}965517 \left[806 + t + t' \right] \left[\log M + \log (9600 - T + T') - \log m - 3{\cdot}982271 \right] \quad . \quad . \quad . \quad . \qquad (14)$$

Example—

Barometers.	Thermometers. Attached.	Thermometers. Detached.
M = 29·98,	T = 63°	t = 62 lower station.
m = 26·17,	T′ = 47	t' = 45 upper "

Substituting in (14),

$$\left.\begin{aligned} h &= 68{\cdot}965517 \left[806 + 107 \right] \left[\log 29{\cdot}98 + \log 9584 - \log 26{\cdot}17 - 3{\cdot}982271 \right] \\ &= 68{\cdot}965517 \times 913 \times \left[1{\cdot}476832 + 3{\cdot}981547 - 1{\cdot}417804 - 3{\cdot}982271 \right] \\ &= 68{\cdot}965517 \times 913 \times 0{\cdot}058304 = 3671{\cdot}1415 \end{aligned}\right\} \qquad (15)$$

(2.) From Belville's "Manual of the Mercurial and Aneroid Barometers."

Let h = difference of level of two stations; A the mean height of the barometers in inchess; a, their differeuce; b, the number in the following Table corresponding to the mean height of the thermometers; then,

$$h = \frac{30\,a\,b}{A} \quad . \quad . \quad . \qquad (16)$$

(16) is the formula of Sir George Shuckburgh; it is empirical, and gives results rather greater than those of (14); but the experiments of Sir George are regarded as being very exact.

For the Aneroid, Belville gives this formula:

As the sum of the readings : is to their difference : : 55000 : the difference of level.

Let h = difference of level of two stations; M and m the readings of the barometer at them; then,

$$h = 55000\,(M - m)\,(M + m)^{-1} \quad . \quad . \qquad (17)$$

The results of (17) correspond pretty well with those of (16).

Table *of Sir George Shuckburgh giving the factors corresponding to the mean of the thermometers*

Ther.	Factor.	Ther.	Factor.	Ther.	Factor.	Ther.	Factor	Ther.	Factor	Ther.	Factor
30°	864·4	39°	883·4	48°	902·3	57°	921·4	66°	940·3	75°	959·3
31	866·5	40	885·4	49	904·5	58	923·5	67	942·4	76	961·4
32	868·5	41	887·5	50	906·6	59	925·6	68	944·5	77	962·5
33	870·6	42	889·6	51	908·7	60	927·7	69	946·7	78	965·6
34	872·7	43	891·7	52	910·8	61	929·8	70	948·8	79	967·7
35	874·9	44	893·8	53	913·0	62	931·9	71	950·9	80	969·9
36	877·0	45	896·0	54	915·1	63	934·0	72	953·0	81	972.0
37	879·2	46	898·1	55	917·2	64	936·1	73	955·1	82	974·1
38	881·3	47	900·2	56	919·3	65	938·2	74	957·2	83	975·2

(3) From Boye's Pneumatics.

Adopting the same notation as in (14), and representing by L the latitude of the place—

$$h = h' + h'' - h''' + h^{\text{IV}} \quad . \quad . \quad . \qquad (18)$$

$$\left.\begin{aligned} h' &= \Big[\log \big(M\,[1 + 0{\cdot}0001001\,(32^\circ - T) - 0{\cdot}0000104\,(62^\circ - T)] \big) \\ &\quad - \log \big(m\,[1 + 0{\cdot}0001001\,(32^\circ - T') - 0{\cdot}0000104\,(62^\circ - T')] \big) \Big] + 60158{\cdot}5; \\ h'' &= 0{\cdot}00111\,(t + t' - 64)\,h'; \\ h''' &= 0{\cdot}0028371 \cos.\,(180^\circ - 2\,L)\,(h' + h''); \\ h^{\text{IV}} &= \frac{h' + h'' - h''' + 52252}{20886861}\,(h' + h'' - h''); \end{aligned}\right\} \qquad (19)$$

(18) is the most correct formula (theoretically), of the four which have been given. It takes into consideration nearly all of the errors which can be corrected in the ealculation. For extreme theoretical aceuraey, M and m should also be corrected for *horary variation.*

In applying (18) care must be taken to give to h'', h''', and h^{iv}, their essential algebraie signs. h'' is usually positive, and varies from ·03 to ·06 of h'.

The essential sign of h''' will depend upon the value of L. If L is less than 45°, cos. (180°—2 L) will be negative; and the term—h''', will become + h'''. h^{iv} is always positive.

If the latitudes of the stations differ, L may be taken as their mean.

h''' and h^{iv} are usually so small that they may be omitted when only ordinary aecuracy is necessary. Negleeting them, (18) beeomes,

$$h = h' + h'' \qquad . \qquad . \qquad . \qquad (20)$$

The values of h' and h'' are obtained from equations (19).

The formula by which the results in the "Report" were obtained is not given. This is a grave oversight on the part of Lieutenant W., or his computation. The principal reason for instituting the comparison between the two instruments, was to determine their relative accuracy; and it is not sufficient to give merely the results of the computations; processes and formulas should be given in full. Different investigators have deduced different formulas, and these do not give the same results. In instituting a comparison between the two instruments, the particular formula used in the computations should be given, for any other will not, probably, give the same results.

For engineering purposes the formula should be as simple as possible.

Should this reach the eye of Lieutenant W., it is hoped that he will eommunicate the formula which he employed.

For more particular information with regard to the philosophy of the barometer, its construction, &c., the reader is referred to "Boye's Pneumatics," "Belville's Manual," "Williams's Geodesy," and works on natural philosophy generally.

The following Tables are given as being not devoid of interest, in eonnexion with this paper, which treats of the relative accuracy of the level and barometer:—

(*a*)

	S. Barom.		A. Barom.		Hygrom		Lev.
Hr.	Barom.	Th.	Baro.	Th.	W.B	D.B	
7	28·942	61°	28·937	60°	56°	59½°	4·742
8	28·950	68½	28·962	65	59½	65½	4·736
9	28·964	73	29·000	69½	63	70	4·724
..	..	..	..	..	..	..	4·741
10	28·970	76	29·025	74	66½	74	4·770
..	..	..	..	..	..	..	4·734
11	28·950	78	29·025	77½	70	78	4·736
12	28·952	83	29·025	81	71½	81½	4·725
..	..	..	..	..	..	..	4·732
1	28·930	84	29·012	83½	73	83½	4·722
..	..	..	..	..	..	..	4·734
2	28·912	86	29·006	85	74	86	4·711
..	..	..	..	..	..	..	4·742
3	28·900	85½	29·000	86	74	85	4·684
..	..	..	..	..	..	..	4·740
4	28·900	85½	29·000	86	74½	85	4·715
..	..	..	..	..	..	..	4·740
5	28·900	87½	28·981	85½	75½	84½	4·714
..	..	..	..	..	..	..	4·836
6	28·9000	82	29·006	85	74	82	4·730
..	..	..	..	..	..	..	4·735

(*b*)

	S. Barom.		A. Barom.		Hygrom		Lev.
Hr.	Baro.	Th.	Baro.	Th.	W.B	D.B	
3⅔	29·100	82½°	29·250	84°	78°	84°	3·978
5	29·110	82	29·262	84	77½	84	4·041
..	..	..	..	..	..	..	3·982
6	29·118	82	29·262	85	77	83½	4·000
..	..	..	..	..	..	..	3·985

(*c.*)

7¾	29·142	76	29·312	75½	..	..	4·180
9	29·200	76	29·312	76½	72½	75	4·184
10	29·200	79½	29·330	78	75	78½	4·167
..	..	..	..	..	..	..	4·180
11	29·212	82	29·350	80½	76	81	4·192
..	..	..	..	..	..	..	4·184
12	..	..	..	..	..	..	4·197
..	..	..	..	..	..	..	4·184

(*d.*)

3	29·134	87	29·305	86	78½	86	4·083
4	29·130	87	29·325	86	77	85½	4·000
..	..	..	..	..	..	..	3·992
5	29·192	85½	29·250	85½	79	86	4·092

The observations in Table (*a*) were made on the 30th May, 1857; all of the instruments, except the level and rod, were indoors; the rod was kept in the shade; the teleseope of the level ranged about E. and W.

The observations upon the level were made without any anticipation of the results whch followed. At 7 A.M., it was carefully levelled and elamped; after whieh the clamp and tangent screw were not touched until the observations for the day were over. The rod was 66 ft. from the level. At 8 o'clock the bubble was observed to be displaced, but the instrument was levelled by means of the levelling screws, before the reading was taken. Afterwards, two readings of the level were taken at the expiration of every hour; one before levelling, and one after. The numbers at the extremities of the dotted horizontal lines are the readings after levelling. There was a good deal of wind during the day, from the south; clouds commenced to gather also, and during the next two days there was much rain.

These faets are mentioned as affecting the barometer-readings; they are not supposed to have influenced those of the level. Curiosity having been excited by the differences of the level-readings, opportunity was taken to verify them by other observations. Those recorded in (*b*) were made during the afternoon of August 7th, 1857. The telescope ranged about N. and S.; the rod was 66 ft. south of the level.

On the following morning the observations recorded in (*c*) were made. The telescope ranged N. and S., and the rod was 66 ft. south of the level.

During the afternoon of the same day, the observations in (*d*) were made. The telescope ranged E. and W., and the rod was 66 ft. on the west.

In the notes giving the observations recorded in (*b*), (c), (*d*), nothing is said about the state of the weather, and the presumptiou is, that it was ealm and fair: such also is the recolleetion of it.

(*e*)

	S. Barom.		A. Barom.		Hygrom.		
Hr	Baro.	Th.	Baro.	Th.	W.B	D.B	Lev.
7	29·310	50°	..	..	..	..	..
8	29·330	58	29·342	56°	..	..	4·988
9	29·344	63½	29·392	62	..	..	5·252
..	..	..	..	..	..	..	4·902
10	29·354	66½	29·408	66	..	..	5·000
..	..	..	..	..	..	..	4·982
11	29·350	70	29·425	69	..	..	4·983
..	..	..	..	..	..	..	4·973
12	29·344	72	29·425	72½	..	..	4·973
..	..	..	..	..	..	..	4·980

(*f*)

	S. Barom.		A. Barom.		Hygrom.		
Hr.	Baro.	Th.	Baro.	Th.	W.B	D.B	Lev.
1	29·336	74°	29·412	71°	..	..	5·020
2	29·322	75	29·412	75	..	..	5·092
..	..	..	..	..	..	..	5·024
3	29·336	76	29·418	77	..	..	4·980
..	..	..	..	..	..	..	5·030
4	29·336	82	29·462	84	..	..	4·940
..	..	..	..	..	..	..	5·030
5	29·330	72½	29·425	75	..	..	5·030
..	..	..	..	..	..	..	5·037
5½	29·328	71	29·412	73	..	..	5·037

Fair, but rather windy.

The observations recorded in (*e*) were made during the morning of 18th September, 1858; those in (*f*) during afternoon of same day.

The variations of the level-readings are attributed to unequal expansion and contraction of the parts of the instrument; but to whatever cause they may be due, it is evident that the bubble will not remain stationary for any great length of time, when the instrument is exposed to the sun.

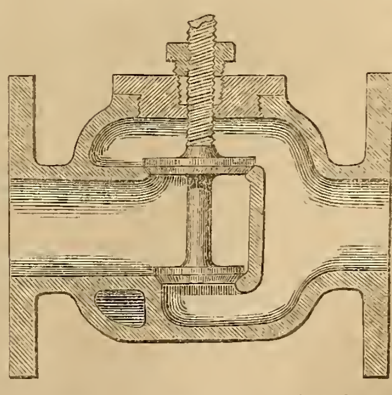
It very frequently happens that mueh time elapses, after a back-sight has been taken, before the next fore-sight can be made; during this time the bubble will probably be displaced, and the question arises should the level-man restore the bubble to the middle of the tube before making the next reading? The observations with regard to this source of error have not been sufficiently multiplied to warrant a decided reply to the question; but the general result, thus far, seems to indicate that he should. This subject merits, and it is hoped that it will reeeive, the attention of engineers. Upon the accuracy of the spirit-level depends the correctness of their calculations with regard to many of the most important and eostly operations in railroad engineering. The error due to this variation of the reading, whatever may be the cause of the displacement of the bubble, will increase as the distance of the rod from the level is increased. In the foregoing observations the rod was placed 66 feet from the level each time. Calling the error for 66 feet, a; the error for 100 will be, 1·5 a; for 200, 3 a; for 300, 4·5 a; and so on, in arithmetical progression.

It will be observed from the Table, that when the teleseope ranged E. and W., the bubble ascended to the west end of the tube in the morning, and the east end in the evening.

Care was taken to plaee the levelling-rod in the same spot at each observation. It was supported upon a broad and hard-bearing surfaee, to prevent it from settling in the ground.

A. P. HOW'S PATENT STOP-VALVES.

THE accompanying illustration exhibits an excellent contrivance invented by Mr. How as a substitute for the ordinary stop-valves in use for opening against considerable pressures; its principle is similar to the double-beat balance valve, Mr. How having made an excellent adaptation of it to coeks and valves, as will be seen by reference to the aecompanying longitudinal section.



The lever handle or hand-wheel, applied to the top of the screw for turning it and opening and closing the valves, is not shown; but it would be better understood, that upon turning the serewed double-button valve, they will be raised from their seats, and, the fluid pressure on the top of the lower valve being very nearly the same as that upon the underside of the upper valve, the power required to open or close the passage-way is but little more than that due to the friction of the serew. This stop-valve will be found very useful wherever pressure has to be eneountered.

ENAMEL WITHOUT LEAD ON BAR AND SHEET IRON.

By M. Pleischl.

The author gives two recipes for the enamel, viz:—

1.		2.	
Silica	from 30 to 50 parts	Quartz	from 30 to 50 parts
Flint	„ 10 to 20 „	Granite	„ 20 to 30 „
Kaolin	„ 10 to 20 „	Borax	„ 10 to 20 „
Pipe clay	„ 8 to 16 „	Glass	„ 6 to 10 „
Chalk	„ 6 to 10 „	Magnesia	„ 10 to 15 „
Pulverised porcelain	„ 5 to 15 „	Feldspar	„ 5 to 20 „
Boracic acid	„ 20 to 40 „	Effloresced carb. soda	„ 10 to 20 „
Nitre	„ 6 to 10 „	Lime	„ 5 to 15 „
Gypsum	„ 2 to 6 „	Sulphate of baryta	„ 2 to 8 „
		Fluor-spar	„ 3 to 6 „

Each of these substances to be powdered separately as fine as possible, mixed carefully and fused with an enamel; this is again ground, and applied to the objects, which are then furnaced. The proportions indicated may vary very much with the different kinds of utensils which are to receive it. The coat should be thin, otherwise it will crack in heating or cooling, and the objects coated should be cooled as slowly as possible, so as to prevent the enamel from shrinking irregularly and cracking.—*Bull. Soc. Encour. de l'Indus. Nat. (Paris.)*

AMALGAMATING ZINC.

M. Berjot has just discovered and communicated to the Academy of Sciences, at Paris, what he considers a new and advantageous mode of amalgamating zinc, by a liquid formed by dissolving 200 parts of mercury in aqua-regio and adding hydrochloric acid. If he will wet his zinc with the acid, and then rub with nitrate of mercury, he will find less trouble and equally good results. We can hardly believe that the manufacturers of galvanic batteries in France have been in the habit of amalgamating, as M. Berjot states, by immersing the zinc in acidulated water, and rubbing metallic mercury on them with a brush made of fine copper wire. If they have, they have been unaccountably behind the art, and we would recommend M. B's. process to them.

WATER-PROOFING STUFFS.

Take a pound of gelatine, and a pound of neutral tallow-soap; melt them in $4\frac{1}{2}$ galls. of water, and add little by little $1\frac{1}{4}$ lbs. alum; continue to boil for a quarter of an hour; wait until the milky-looking liquid has come down to 113°, then plunge the stuff into it, allowing it to become well soaked. Take it out, let it drip, and dry it completely by hanging it up without wringing; wash it carefully, dry it again, and calender it. The soap must be made with tallow, for no other fatty matter will remain suspended in the gelatine.—*Bull. Soc. Encour. de l'Indus. Nat. (Paris.)*

INSTITUTION OF CIVIL ENGINEERS.

January 25, and February 1, 1859.

Joseph Locke, Esq., M.P., President, in the Chair.

The discussion upon Mr. M. Scott's Paper, Description of a Breakwater at the Port of Blyth, and of certain Improvements in Breakwaters, applicable to Harbours of Refuge, occupied four evenings.

Before proceeding with the discussion, it was remarked, on behalf of the author, that an error had been overlooked in the abstract of the paper. The abstract stated, that the breakwaters at Alderney, Portland and Holyhead had sections which presented nearly, if not all, the advantages of the vertical wall; whereas they were in direct antagonism with the principle of the vertical wall. Now, what it had been intended to convey was, that the experience at those places had shown, that the sea did not disturb rubble at a depth of 15 ft. below low water; and that there was a combination of the vertical wall and slope, which was nearly equal to a vertical wall; as when a nearly perpendicular wall was built upon a rubble mound, as near to the edge of the slope as was consistent with the safety of the foundation; the surface of the mound being 15 ft. below low water, and the slope being the natural one of about 1 to 1.

In allusion to a remark, that the pier at Blyth acted like a breakwater, and at the same time as a training wall to conduct the water, it was observed, that it was important to ascertain whether the prolongation for a length of 4,000 ft. or 5,000 ft. of the natural breakwater, formerly an outlying ridge of rocks, in a direction to intercept the set of the flood tide, had produced any effect on the tidal flow up the river, which had originally extended four or five miles inland. Also, whether any observations had been made as to the vertical rise of the tide, and the extent of the flow, previous to the commencement of the works, and since their completion; and whether any comparison had been instituted between the two series of observations, the average of a number of tides being taken; because it was believed that the tidal flow was perceptibly diminished. In the river Wear, prior to the construction of the north pier,—that on the south having been previously erected,—a wide mouth was exposed to the N.E., which allowed a large quantity of water to pass into the river, causing the tidal flow to reach two miles higher up the river than at the present time. There was likewise a difference of 4 or 5 ft. in the present tidal flow, at nine miles from the mouth of the river, and quays were in existence, in the upper parts of the river, which were at present 10 or 12 ft. above the high-water mark.

It was stated, that wooden piers, nearly similar in construction to one of those described in the paper, had been adopted in the river Wear, upwards of seventy years ago, by Mr. Shoot, the engineer at that period. The carcasses were built on the land, in lengths of 30 ft., and launched into the river, loaded with large stones, being floated to their positions, and sunk on the sand, at about the level of low water. Instead, however, of the interior being filled up with rubble, as suggested in the paper, the river and outer walls were built up with large blocks of stone, like an ordinary pier, so that when the timber became affected by the worm, the wall remained tolerably perfect. The timber was not so much eaten away by the worm, on the river side, as on the seaward face; and on taking down some of these old piers, the cills which had been buried in the sand were found to be quite perfect.

It was contended, that breakwaters having long flat slopes, were more liable to be damaged than those with nearly vertical walls; not perhaps so much by the direct action of the sea as by the recession of the waves, when the efflux of the water through the open joints tended to disturb the materials, and when once they were deranged, a breach was certain to occur. It was believed that, in many instances, a redundancy of material had been employed in the construction of breakwaters. It was well known that the violence of the sea did not extend more than 15 ft. below low water, and as all that was required was still water inside a breakwater, it was worthy of consideration whether the sections adopted had not, in many cases, been too broad and too large for effecting that purpose. Then, again, the materials used as "pierre perdue." would rarely be found to take an inclination greater than 1 to 1. Thus, it would appear, that an unnecessarily large expenditure was frequently incurred; whilst if a cheaper and equally durable system was adopted, a greater number of these essential works could be undertaken. With reference to the pier at Dover, it was remarked, that before the present works were commenced, it had been suggested that a simple embankment, similar to a railway work, should have been formed from the materials of the adjacent cliffs, by which means a harbour of refuge would have been obtained at a comparatively trifling cost, and in less time than had already been spent upon the new works. It was thought, that as these works already afforded a quay, both for embarking and disembarking passengers, their further extension seawards should be executed in a rough manner, so as merely to prevent the sea from breaking into the harbour. An opinion was also expressed, that it would have been more correct to designate the work as the "Wellington Pier," rather than the "Admiralty Pier," as but for the interest which the great Duke took in the matter, the pier would probably never have been executed. The effects of breakwaters upon the adjacent coasts ought to be narrowly watched, or else it might happen that they would cause the destruction of other ports.

The piers, or jetties, of Calais and Boulogne, which had been constructed after Vauban's jetty at Dunkirk, and had been alluded to in the Paper as being similar to that at Blyth, might be cited as examples of successfully constructed works, well adapted as breakwaters for a flat sandy shore, serving at the same time as conductors and protectors to a channel, into and out of the harbour. It was doubted, however, whether this system could be applied to an isolated breakwater in deep water, exposed to the violent action of the waves. It should also be remembered, that the western, or Old Mole of Genoa, which had been formed of caissons, or chests of timber, filled with stone and cement, on which a superstructure was raised to a height of 18 ft., had occupied twenty-six years in advancing 340 yards in length; and that the action of the waves on the face was such as to necessitate large stones, 15 tons in weight, being thrown down in front of it, in a depth of water of 60 ft. The destruction of the celebrated cones at Cherbourg might also be mentioned, as affording another illustration of the disadvantages of that system of construction.

It was stated, that the Admiralty Pier at Dover was formed of a hearting of large blocks of concrete, composed of Portland cement and shingle, and faced with granite. The width of the pier was about 80 ft. at the base, and it was founded 45 ft. below low-water mark, up to which level it was built by divers. The blocks were continued to a little above half-tide level, and above that point ordinary concrete was filled in between the granite faces. It was intended to have a parapet of Bramley Fall stone, on the sea side, but that was not yet constructed. The pier had already been useful for sheltering vessels coming into the old harbour, as well as in forming a landing and embarking-place for passengers. It was thought that its extension further seaward, would be attended with corresponding advantages, as large vessels would be able to come up to the pier. The estimated cost for a length of 1,800 ft., including the parapet, was £650,000.

In regard to a statement in the paper, that the cost of the works at Portland had been £150 per lineal foot, it was stated, that the most expensive part of that work, in the deepest water, with the superstructure complete, and including the parapet and a wall 40 ft. in width, had not exceeded £120 per foot.

It was considered, that sufficient distinction had not been drawn between breakwaters intended for deep water, and those designed for shallow seas; and that there was a wide, practical difference between the two kinds, which required to be allowed for in their construction. Timber had been shown to be a useful material for making barriers against the sea, on the east and on the south coasts of England, on the coast of Holland, at Boulogne, at Calais, and at other places; but none of these were cases of deep-water piers, and it was below low water that the great difficulties were encountered. In the construction of a deep-water pier, at Mill Bay, near Plymouth, where the plan of dropping stone vertically, from a timber stage, was first put in practice, it was found, that the number of pile supports and of timbers must be reduced to a minimum, so as to allow the water to pass through without resistance; the timberwork thus becoming a mere accessory to the permanent structure. At the Plymouth breakwater, some of the largest stones had been driven out of the top pavement and the inside slope. All experience went to show, that in designing works, which had to contend with deep-sea waves, the greatest possible weight and solidity must be obtained, that was practicable with the material at hand.

Allusion was made to a design for a breakwater, combined with a landing stage, or pier, constructed of iron and wood. A vertical wall of creosoted timber, with a broken or unbroken surface, was supported in its position by wrought-iron piles, with Mitchell's screws as foundations, firmly tied and braced together. It was considered, that such a system of structure would greatly facilitate the construction, lessen the time occupied, and reduce the cost.

In a supplementary Paper "on the Form and Cost of Breakwaters, applicable to Harbours of Refuge," by Mr. J. Murray, M. Inst., C.E., it was remarked, that a harbour of refuge did not require the enclosed water area to be as tranquil as in a wet dock, where vessels loaded and discharged their cargoes alongside of quays. A little undulation in the outer harbour was not objectionable; and the protecting moles, or piers, would fully answer their purpose, if the great force of the waves was broken, and they were thus prevented from doing injury to the vessels at anchor inside.

It appeared to be generally admitted, as to the work under low water, that rubble-stone, used as "pierre perdue," remained stationary, until it attained a height of 12 ft. or 15 ft. under low water; that the slopes of the deposited mass assumed an angle of 45°, or an inclination of 1 to 1; and that this was the cheapest mode of bringing up the works to that level. In corroboration of this latter statement, a comparative estimate was made, of the cost of bringing up, by diving-bell work, an upright mole from the bottom, in a depth of 6 fathoms, with a spring tide rise of 16 ft. and of a simple deposit of rubble-stone of the requisite width to receive the superstructure, for which purpose a berm, or bench, of 10 ft. on each side, was added to the other profile. The estimated cost amounted, in the former case, to £296 per lineal yard, and in the latter to £37 per lineal yard, both exclusive of staging; while the time required to be bestowed, in the construction of the former, would be far greater than for the latter. The upright mole would, also, be considerably augmented in cost, if the facing of the walls were of granite, and the interior filled with level courses of concrete blocks, in the manner now being pursued at Dover.

With regard to the superstructure, it was estimated, that the cost would vary thus, according to the form adopted:

1st. When constructed on a rubble stone deposit, brought up to 12 ft. under low water, and having a sectional area of 4,149 superficial ft	£300 per lineal yard
2nd. Of completing the upright mole, with outer and inner walls, and having an area of 3,200 superficial ft..	£558 „ „
3rd. With rubble-stone blocks and cement	£330 „ „
4th. With concrete-blocks	£303 „ „

All these systems were, however, expensive, because skilled labour was employed, to a considerable extent, in the construction; whereas, for the purpose of a breakwater only, this item should be reduced to a minimum.

In the construction of rubble-stone breakwaters, it was considered that the system pursued by the French engineers—of not mixing any small material with the large blocks, as practised at the mole of La Joliette, at Marseilles, and to be adopted at the new mole D'Arène, was the correct principle; for there the large blocks were only used where required, and were not unnecessarily wasted by being sunk into the heart of the work. By this plan it had been found, that perfect consolidation was attained, with a saving of material. Acting on this principle, it was proposed that, for a breakwater in the assumed depth of 6 fathoms, the nucleus, or core, from the bottom to 22 feet under low water, should be wholly composed of third-class rubble, or from quarry rubbish to blocks of half-a-ton in weight; that this should be coated with second-class rubble, from half-a-ton to 2 tons in weight, which it was considered would remain stationary, up to 12 feet under low water; and that first-class rubble in blocks weighing from 2 to 5 tons, should then be employed up to low water, with a berm, or bench, on the sea side, at a depth of 12 feet under that level. It was further suggested, that the upper part should be formed of béton blocks, of 20 to 25 tons in weight, being of sufficient gravity to resist the force of the waves, not, however, as a coating, but as a mass, and terminating at the level of high water; then for 10 or 12 feet above that height, two or three courses of heavy blocks, bonded and adjusted by manual labour, should be laid. It had been found at Marseilles, that these béton blocks cost 5½d. per cubic foot, and at Algiers something more; that the interstices between the blocks amounted to one-third of the cubic contents; and that the blocks arranged themselves at an angle of 45°, or an inclination of 1 to 1. Assuming, however, the price to amount to 8d. per cubic foot, and that the section adopted had an inclination of 2 to 1 for the sea side, and 1 to 1 for the inner slope, then the cost per lineal yard would only amount to £200, which contrasted favourably with the estimated cost—£300 per lineal yard—of a mole, founded on a rubble deposit, being a difference of £176,000 in a mile of breakwater, or, if the comparison was made with an upright wall from the bottom, the saving would amount to £630,000—a sum sufficient to construct an ordinary harbour of refuge.

In reference to the calculated cost—£150 per foot—of the Portland breakwater, it was remarked that the basis of the calculation was in the reports laid before Parliament. From the last report it appeared that the total length already executed was 5,907 feet, including the entrance, 400 feet wide; and that the cost had amounted to £715,919. In this sum was included the cost of a coal store and jetty, which might be set down at £20,000, and of a length of superstructure of about 1,200 feet, irregularly constructed, which, at £35 per foot, would amount to £42,000. These being deducted from the gross cost, left an amount of £653,919, which, being divided by the total length of the pier, gave £111 per lineal foot. To this must be added the price of the superstructure, bringing up the sum to £146 per foot, supposing the superstructure to be completed. But as the value of the convict labour was not allowed for in the cost of the work, the Author had considered that the amount should be increased by whatever that was worth; taking convict labour, as compared with free labour, to be as three to eight nearly, being the proportion assigned to it by the engineer of the breakwater, or equivalent to 1s. 1½d. per day, then the value of the labour of 800 convicts, employed during the ten years the work had been in progress, would amount to £24 per foot run, making the total cost £170 per foot, whereas it had only been stated at £150 per foot.

In reply, it was stated, that the cost of the works, as given in the Parliamentary returns, included all the preliminary expenses, amounting to about £80,000 or £90,000, some portion of which had been incurred for special reasons; and that these charges must, in fairness, be distributed over the whole of the work, when it should be finished, as well as over all the contingent works. It was maintained, that in the most expensive portions, the Portland Breakwater had not cost £120 per foot. The convict labour had not been charged to the cost of the breakwater, and it had yet to be ascertained whether that would affect the result. There were contingencies connected with the employment of such labour, which, although only subject to a mere nominal charge, would materially add to the cost in several other respects. The risk was greater, and the works would take a longer time in construction, more especially with a timber stage; and under no other system would it be possible to employ convicts, with any chance of a profitable result, or with that degree of regularity and freedom from stoppages during gales which was so essential. At Portland, the works had only been delayed from this cause from ten to twenty days during ten years. Then to do the same quantity of work in the same time, the "plant" must be greatly increased—say in the proportion of 8 to 3—and it must also be of a special description, suitable to unskilled labour; added to which it would be more liable to damage when used by men without skill and without experience; so that, strange as it might appear, it was much doubted whether any pecuniary saving had hitherto resulted from the employment of convict labour. Now, however, by the employment of free labour in particular parts of the work, the rate of progress was being increased, and the scale was being turned in favour of the employment of convict labour.

It was remarked that when a wave reached a vertical wall, it was immediately reflected back, producing the converse of itself; and this again gave rise to two reflected secondary waves—one vertically upward, and parallel to the face of the wall, and the other downwards. If the wall was situated in water of a moderate depth, and was founded in or upon sand, mud, or other soft material, a hollow trough would become excavated along the base of the wall by the reflected wave; and unless it was founded deep, its base might be undermined. This actually occurred at the Commercial Wharf, Kingstown Harbour, some years ago. The seas which washed over the wall falling forward into the water of the lee side, also produced a wave by their impulse which penetrated to the bottom, and produced at that side another but smaller trough along the base of the wall. The remedy adopted was to fill the troughs, on both sides, with angular shingle concrete made with Aberthaw lime.

It was observed, that if timber could be rendered permanent, it might be advantageously employed in the construction of breakwaters, inasmuch as by its use there would be obtained a continuity of structure, which stonework did not possess, unless the materials were of very large size. The structure at Blyth had been exposed to the action of heavy seas from the N.E. for two years, without accident. It was thought that an improvement might be effected in carrying out stone breakwaters, by means of timber staging, by constructing a permanent stage, carefully put together for the whole length of the intended works, and loading it with rubble stone, so as to form for a time a breakwater in itself. The stage should be sufficiently strong to carry machinery, capable of lifting and transporting masses of masonry, constructed on shore, of twenty-five or thirty tons in weight, and of depositing them on the stone facework continuously, and progressing along its whole length instead of from the end merely.

It was remarked, that the estuary at Blyth was similar to that of the Mersey, admitting a large quantity of tidal or back-water. Originally, during N.E. gales, there was no protection to vessels entering the tortuous channel leading to the harbour, and numerous wrecks took place upon the sands to the eastward; while in S.E. gales vessels went upon the ridge of rocks. The breakwater had acted as a guiding-wall to the current, and a straight channel had been dredged out; an additional depth of 2 ft. of water had been attained, and vessels were sheltered immediately on entering. So far, therefore, the structure was successful, and had answered the purposes required.

It was stated that, in 1814, the late Mr. Rennie made a report upon the harbour of Blyth, in which he proposed the erection of a stone breakwater, in a similar direction to that now under construction, and also to widen and deepen the entrance channel, jetties being intended to be carried out from the south shore to preserve the channel. The estimated expense of these works was £47,079, or, for the pier alone, £38,015, being at the rate of £9 5s. per foot; whilst the present pier was stated to have cost £10 per foot; so that no great pecuniary advantage had been gained by the adoption of the system of timber and stone combined. This mode of construction was by no means so novel as it appeared to be considered, for it would be found described in the works of Vauban, Belidor, Sganzin, and other French writers. It had also been carried into effect at Dunkirk, Calais, Boulogne, Dieppe, and other places on the French coast, where there was no means of getting other materials. It was thought that this system could not be applied with propriety to deep-water sections; and it was mentioned that several extensive works had already been executed in stone at about £70 per foot. For example, at Kingstown Harbour about 9,500 lineal ft. of pier were executed at £73 per foot, in a depth of water of from 12 ft. to 27 ft. at low water spring tides, with a rise of tide of from 8 to 16 ft. Again, at Howth, where, in 1812, the "pierre perdue" system was first used, it was believed, in this country, the quay-walls and parapet cost only £71 per foot. The Plymouth Breakwater, which was built in a depth of 7 fathoms of low-water spring tides, cost £294 per foot, including the masonry, which was expensive; but that was an instance of an isolated breakwater, to which all the materials had to be conveyed a distance of nearly 7 miles in sailing-vessels, and at a time when the machinery and plant for executing works of such magnitude were not so perfect as at the present day.

It was observed, that the cost of the Holyhead Breakwater had been about £160 per foot, not £200 per foot, as given in the paper. It was urged, that it was impossible to come to a conclusion that any one system of breakwater could be universally adopted; and, indeed, in no branch of engineering was there one material, or one mode of construction, proper to be employed, under all circumstances. With regard to the particular system under discussion, it was remarked, that there was nothing new in the design; for wooden piles, with or without stone thrown behind them, had been generally used where no better material could be afforded. In the United States, twenty years ago, with the exception of a single graving dock at Boston, it was believed that there were no walls, either of docks, quays, or piers that were not so constructed. It was thought that loose stones, requiring the support of the timber to keep them together, would not stand in such rough seas as the breakwaters at Holyhead, Portland, and other places, were exposed to; and if that part of the structure was only intended as a nucleus for a permanent stone masonry structure—from which to build stone walls in water 70 ft. in depth, then it was much questioned whether there would be any economy in construction.

In reference to comparisons of the cost of different breakwaters, it was remarked, that the cost of a wooden structure, in one place, could not fairly be contrasted with the outlay incurred in another situation, under totally different circumstances, and on entirely dissimilar works. Great care was required, even in contrasting the cost of stone breakwaters in different places; for the rock in one case might be much harder, more difficult to quarry, and more expensive to carry, than in another.

It was contended that, in the construction of breakwaters, the objects for which they were required were not sufficiently kept in view; and that unnecessary labour and expense were incurred in rearing a superstructure, which was not at all necessary. It frequently happened that the parapet, by opposing a barrier to the waves, caused the water to fall on the platform within, and to disturb and destroy the work.

It was remarked, that to execute a structure of the kind described in the paper, in a depth of water of 60 ft., it would be necessary that the timber frames should be upwards of 80 ft. in height. Judging from the difficulty of placing single piles in position in a less depth of water, it was argued that the setting up of each frame with precision in a rapid tideway, which generally prevailed round the head of a breakwater in progress, would be a matter of considerable difficulty. It was doubted whether the manœuvring of such large masses of buoyant material could be accomplished with advantage, even where it was practicable. It was thought that where there was only a small base of rubble, it was preferable to float the material to the spot, as had been done at Alderney, rather than to adopt the method of depositing it from a stage. For executing the superstructure, it had been proposed to introduce intermediate frames resting on the rubble. Supposing the rubble to sink, which it undoubtedly would do to some extent, then either the intermediate frames would receive no support from the substratum, and they must be held in suspension by the main frames, or, on the other hand, if they were sustained by the rubble, the continuity and rigid attachment of the timber-framing could no longer exist. In either case, a portion of the strength, which seemed to be anticipated, would be lost. Hence, it was believed, that before the superstructure could be proceeded with, the main frames would have to be cut away, so as to present an equally yielding base for the superstructure to rest upon. The relative advantages of timber and stone for these works were then commented upon; and it was thought, that although the first cost might be reduced, by using the former material, yet it would scarcely ever be adopted where heavy seas had to be resisted. Again; if the dimensions of the timber were increased so as to withstand heavy seas, the system would be much more expensive than had been stated. It should also be remembered, that although timber and rubble-stone might be cheaper per cubic foot than stone alone, yet the advantages were not so great, when the comparison was made by weight.

It was remarked that the subject of the harbours of refuge, indepeudently of the mechanical and engineering part of the question, was of vast importance, in a national point of view, whether as relating to the necessary protection of the commercial marine, or as connected with the naval defences of the kingdom. In order to rendering clear the points to be touched upon, it had been necessary to examine those formidable and not very lively documents, the Parliamentary Blue-books, and they confirmed the opinion, that all these great works were being executed without any efficient responsible supervision or control; and that not only the public and the representatives of the nation, but also the Government itself, had been utterly in the dark as to proceedings relative to them. The time had now arrived, when these matters should be brought before the bar of public opinion, and as it was almost impossible to induce a dispassionate examination of the subject elsewhere, the Institution of Civil Engineers appeared to be the most fitting arena for the discussion of the question.

The mechanical portion of the subject was first briefly alluded to, by reference to the Reports of the several Committees on Harbours of Refuge, commencing with that of 1845; which, though not absolutely the first, was that which first actually examined into the most important points. On the question of the recommendation of upright, or of sloping walls, in spite of the aid given by scientific and practical men, the committee differed so widely, that a supplementary report was published, exhibiting the opinions of the dissidents from the first blue-book. Now it was submitted, that this difference of opinion had chiefly arisen from not having arrived at a clear understanding of the terms used, and of the basis of the various arguments employed.

It would not be necessary now to reopen the question of the theory of the waves of oscillation and of translation. It was admitted, that in the case of a pure wave of oscillation, the upright wall would receive the least amount of actual impact; and that the wave would be reflected from the surface, at a corresponding angle to that at which it impinged; but when that wave became a wave of translation, the upright wall was the worst form that could be adopted, as it would be struck with the utmost accumulated force of the sea.

In applying these and other views to practical cases, it must be assumed, that the facts were derived from the Blue-book, which, however, like the Queen's speeches, appeared to contain everything except the specific information sought from them.

Now, in looking at the plans of the works, as given in these Parliamentary documents, the section of the breakwater at Alderney appeared to be of the worst possible form. There was a slope, or berm, below low water, then a slope of 1 in 7, and then an upright wall; it was contended that upon this combination of forms, the effect of the waves must be most pernicious.

When there was to be a vertical wall, the slope should be so placed as to exhaust the force of the waves before they reached the superposed upright wall; this was judicious, and it was evidence of the correctness of the doctrine, that the form of section of sea walls should depend upon local circumstances, and should be fixed by the practical judgment of the engineer. At Dover, a slope would not be practicable as there were only soft materials at command, whereas at Holyhead and at Portland there was abundance of hard material, and it was evident that in these latter positions slopes of "pierre perdue" were the proper kind of works to be executed, as they were less expensive and required the exercise of less engineering and mechanical skill than upright walls. These latter were, doubtless, expensive works, and it was contended that if they could not be constructed at a less expense than the pier at Dover, which was stated to be now costing £415 per lineal foot, such structures must be abandoned. At the present rate of progress, the projected Harbour of Refuge, at Dover, would scarcely be completed in less than one hundred years, and at an outlay of £5,000,000. But the actual cost would not be represented by that amount, as if the interest of that sum was spread over the hundred years consumed in the progress of the work, it would, with the principal, amount to £40,000,000. Supposing, then, that our ancestors had commenced this harbour at Dover in 1759, what would have been its utility as a work of military defence during the past prolonged continental struggles, and would not £40,000,000 be much more usefully employed in reduction of the National Debt than in a work of doubtful utility, either for the commercial marine or for the navy? If such works must occupy even fifty years, they had better not be commenced at all; as by the time they were completed, the perils they were intended to guard against would have passed away. The great object, then, must be to devise some other and simpler system of construction for works of this kind; and it was a question whether some such plan of breakwater as those of which drawings and models were exhibited by Mr. Hays, Mr. Brunlees, or Mr. Johnson, could not be adopted with advantage; those systems appeared to consist of iron piles, founded upon Mitchell's screws, and bearing a sheathing of close or open timbers, against which the waves would impinge. The system appeared to possess certain merits, and, under peculiar circumstances and in properly selected localities, could probably be made available, as a considerable length could be put down in a short space of time; and in the hands of experienced engineers such a mode of construction might be rendered available for reducing the present enormous cost of piers and works intended for the protection of shipping. With the diving-bell and helmet, and the Nautilus and other available means of securing the putting down of any kind of iron piles, it would appear easy if these works were thrown open to the engineering skill of the country, to find the means of executing them with much greater rapidity and at considerably less cost than at present.

Reverting to the Blue-books, they would be found to reveal many things which were not generally even surmised. To the Report of 1845 there was appended the signature of Mr. James Walker, past President of the Institution. That report stated that the cost of breakwaters, whether constructed of "pierre perdue," or built as upright walls, would be nearly identical. Now, as a commentary on that statement, it must be observed, as far as a Blue-book fact could be received, that the pier at Dover had cost £415 per foot, and that at Portland less than half that sum. It was further stated that the works at Dover were to cost £2,500,000; those at Seaford, 1,250,000; at Portland, £500,000, and at Harwich, £60,000. Of these four works so recommended, three had been commenced, and two of them had been entrusted to Mr. James Walker, himself one of the Commissioners.

The facts respecting Dover appeared to be, that the first contract was for 800 ft. extending from the shore, at a cost of £234,000, or £290 per lineal foot; and the renewed contract in 1854, was for 1,000 ft. at £415,000, or £415 per lineal foot, and to be completed in 1864. It must be assumed that Parliament sanctioned that work, ordered it to be proceeded with, and voted the money on the report of the commissioners; yet, in 1858, on some of the members of a Committee of the House, expressing surprise at the slow progress of the work, and asking Mr. Walker this question—"Was it known, at the time it was decided to make the works at Dover, that it would take half a century to make them?" he replied—"I do not suppose it was. I do not think any idea was formed at the time as to the cost, or the mode in which it should be done." Hence it might be assumed, that works were authorised, and the money of the country was voted away by the Government without any idea being given of the time of construction, or of the cost of such works, nor even of the mode of their execution. Now mark the result at Dover;—about £400,000 had already been expended, and yet it was at times nearly impracticable to effect the landing at low water of the passengers from the small steamers arriving from Calais until the outward-bound steamer had left. This inadequate result, after such expenditure, was not creditable to the administrative skill of the Government of the country.

At Portland, the original approximate estimate was £500,000, which, for the rough stone alone, was extended to £558,000. It was however discovered, subsequently, that the mass of stone must be wider and deeper, and therefore the cost was increased to £932,000; and it was stated, that this addition was occasioned by an error of 7 ft. 6 in. in the depths, which had been determined by soundings taken by one of Her Majesty's surveying ships, which had been specially deputed to make a chart of Porland Bay. Why an error of this kind, involving an expense of £95,000, had been passed over without any public notice, remained to be explained by the department of the Government which was responsible for it.

Considerable discrepancy of opinion appeared to exist with respect to the value of convict labour, which, it should be remarked, was more extensively employed at Portland than at any other place. Nearly all the stone used in the works was quarried by convicts; it was then taken by the contractor, hauled to the top of the self-acting incline planes (supplied by the Government), and was tipped into the sea vertically from a stage erected by the contractor, who had merely to dispose of the material supplied to him by the convicts. It would, at the first view, have appeared easy to estimate the value of the material, and to charge it against the works executed. This, however, did not appear to be done. It was averred in the Blue-books relating to the Management of Prisons, that the criminal establishment at Portland was self-supporting, inasmuch as the labour of the convicts was profitably employed in the harbour works. On the other hand, it was stated in the Blue-book relative to the Harbours of Refuge, that this labour did "not save one shilling in the work." Now, between these two statements there was a manifest discrepancy, which should be explained, as it was evident that the £30,000 to £50,000 annually expended on the convict establishment at Portland should produce something. The prison authorities said that the establishment cost the country next to nothing, whilst the Admiralty contended that the harbour works upon which the convicts were employed were as costly as if free labour had been employed. Now, it appeared that both were a little wrong; the Inspector of Prisons might perhaps attach more value to the convict labour than properly belonged to it; but it was absurd to say that the quarried stone, delivered on the tramway, ready for deposit by the contractor, was valueless. Indeed, it might be safely contended that the £930,000, representing the ultimate cost of the Portland works, would eventually be increased to £1,500,000, when the convict labour and the interest of the money was taken into calculation.

It appeared from the Blue-books, that the cost of the stone, receiving it ready quarried and lowering it by inclined planes, erected at the cost of the Government, and tipping it into the sea, amounted to between three and four shillings per ton. Now this price appeared excessive, as compared to the cost of similar works in other positions, and it induced the conviction that, if the whole work had been offered to free and open competition, it would have been done at a less cost to the country.

Alluding to the design of the Portland breakwater, it was observed that an opening of between 300 and 400 ft. wide had been left, at a certain distance from the shore, in such a position as to admit of heavy seas rolling in, to the detriment of the anchorage-ground in the harbour, whilst from its position it was manifestly useless for sailing-vessels, either entering or leaving, and could only afford an advantage of three or four minutes even to steam vessels. Besides this opening required elaborately-constructed pier-heads, which, as specimens of work, reflected the highest credit on all who were connected with the breakwater; but they had cost nearly £100,000, which was a heavy cost for a doubtful advantage. Moreover, in any future repairs of the breakwater, this opening would be found to be a source of much inconvenience, as well as of extra cost.

The Harbour of Refuge of Alderney, which was estimated to cost £1,300,000, had been placed in a situation where it was nearly valueless, as all shipping carefully avoided that part of the channel.

The works of St. Katherine's Bay, Guernsey, which were shown by the Blue-books to have cost £300,000, were even, if possible, still less useful, as if a vessel would avoid Alderney it would certainly not go near to Guernsey. The works were now stopped, and, after all the expenditure, there was scarcely shelter for a few oyster boats.

(*To be continued.*)

February 8, 1859.

Joseph Locke, Esq., M.P., President, in the Chair.

The Paper read was On the Performance of the Screw Steam-ship "Sahel," fitted with Du Trembley's Combined Vapour-engine; and of the sister-ship "Oasis," with Steam-engines worked Expansively, and provided with Partial Surface Condensation, by Mr. James W. Jameson.

Before proceeding with the main object of the paper, which was to record the results obtained during twelve voyages of each ship, made for the purpose of testing the comparative value of the two systems, the author gave a brief description of the combined-vapour engine. The principle of this engine was based upon the fact, that the condensation of a liquid, such as water, boiling at a high temperature, might be effected by surrounding an external condenser with a liquid, such as ether, boiling at a low temperature. Thus, the condensation of the vapour of the one might be made the means of generating the vapour of the other; and a useful effect might be obtained from the heat given out in condensation. The engine, up to a certain point, resembled an ordinary steam engine, with surface condensation, except that the surface of the vessel called the vopouriser, which was also the condenser of the steam, was surrounded by ether instead of water. The heat evolved by the condensing steam generated ether vapour. This vapour accumulated in the upper part of the vapouriser, and was conveyed from thence to a cylinder fitted with a piston, &c., precisely like an ordinary steam cylinder, in which the ether vapour exerted its force. From this it was conveyed to another external condenser, where it was condensed by means of cold water, and was then returned to an air-vessel, in which any air that might have entered was separated from the ether. From this vessel it again passed to the vapouriser, in which it condensed fresh volumes of the steam, and was once more turned into vapour. In a steam-boat with a pair of engines, one would be worked with steam in the ordinary way, and the other with the vapour of ether. The vapourisers and condensers were composed of a number of elliptical copper tubes, fixed into brass tube-plates. The tubes were generally 5 ft. in length, 1-25th of an inch in thickness, and the bore was a flat ellipse, measuring 1 in. by ¼ of an in. These tubes M. du Trembley preferred to have drawn solid, without any brazed joint or other seam. The tubes, after having had their ends tinned, were placed in the mould for the tube-plate, and the molten metal was then run round them, by which a very tight joint was made between the ends of the tubes and the plates. Groups of these tubes, properly fastened together, were placed vertically in a cast-iron case, in which the exhaust steam was introduced, so as to surround the outside of the tubes. The liquid ether to be boiled off and to condense the steam was placed within the tubes; arrangements being made above the top tube-plate to collect the vapour, and to prevent its mixing with the steam that surrounded the exterior of the tubes. The condenser was nearly similar to the vapouriser, except that the tubes were placed horizontally, and were curved slightly upwards in the middle, so that the ether obtained from the condensation of the vapour might readily escape from the tubes.

The author then succinctly alluded to the experiments made by Mr. Rennie, on board the ship *Du Trembley*, in the year 1853, which led to the application of the system in two new ships, the *France* and the *Brésil*, of 300 nominal H.P., belonging to the "Compagnie de Navigation Mixte," of the port of Marseilles. These vessels performed an uninterrupted service for upwards of eighteen months, between Marseilles and Kamiesh, during the Crimean war; and were so favourably reported upon by M. Meissonier, Ingéniéur des Mines, and M. Gouin, Ingéniéur des Ponts et Chaussées, that it was determined to apply the system to seven new ships. Ultimately, however, in consequence of the burning of the ship *France*, in the port of Bahia, and owing to the failure of the Brazilian line of steamers after three voyages, the system was only applied to three ships on the African line. These vessels were the *Sahel, Zouave*, and *Kabyle*, of 825 tons displacement, and 180 nominal H.P.

About the same time the "Compagnie Franco-Americaine," having made some incomplete and unsuccessful trials of ether engines, in the ships *Jacquard* and *François Arago*, gave up the system. These two engines were then arranged to work by steam alone, the tubular apparatus being made use of for surface condensers. It was said that by this arrangement such favourable results were obtained as to compensate for the suppression of the ether. All these circumstances combined induced the two companies to engage the services of M. Moreau, to conduct a series of experiments to determine the relative economy of the two systems. In his Report he endeavoured to prove, that although in the combined engine a consumption of 800 lbs. of ordinary Cardiff coal, and 2·16 pints of ether per hour, had produced 439·6 indicated H.P., or 2 lbs. per indicated H.P. per hour, yet a result almost equal to this might be obtained from engines of the same dimensions, by employing steam of the same pressure as in the combined engines, and by using a diminished introduction, a greater expansion, and surface-condensers. Subsequent experiments corroborated the results arrived at by M. Moreau, as to the consumption of fuel; but in a reply to that report the accuracy of his reasoning and calculations was disputed. The Directors of the "Compagnie de Navigation Mixte," however, determined that the plan proposed by M. Moreau should be carried out in the ships *Oasis* and *Marabout*, also belonging to the African line; and this had enabled the present comparison to be made.

The engines and boilers of the two ships *Sahel* and *Oasis*, as well as the hulls, were identical, except that the boilers of the latter had about one-third more heating surface. The voyages, twelve in number, were perfectly similar in all respects, and occupied eight months, during which time about 14,000 miles were run by each ship. During the experiments the mean indicated power was found to be 405 H.P. in the *Sahel*, and 273 H.P. in the *Oasis* and the *Marabout*. In the former the total consumption of coal taken on board was 3·1 lbs. per indicated H.P. per hour, and in the latter 7·12 lbs. per indicated H.P. per hour—that of the *Oasis* being 7·5 lbs., and of the *Marabout* 6·75 lbs. These rates of consumption were obtained by dividing the total amount of coal used on board for all purposes by the actual number of hours under way. They, therefore, included the quantity consumed in getting up the steam, as well as that used for cooking, &c. The rate of consumption was also affected by the inferior quality of the fuel frequently used, by the considerable waste, and by the great number of hours under steam, compared to the hours under way. These rates, though high, did not exceed the usual rates for ships in the port of Marseilles, fitted with direct-acting engines of the same power. The most economical results obtained in any of that class were those of the ship *Avenir*, belonging to the same Company, in which the consumption of fuel, measured in the same way, was 5·4 lbs. per indicated H.P. per hour. This agreed very nearly with the account given of the *Scotia, Anglia*, and *Cambria* mail boats, running between Kingstown and Holyhead, in which the consumption was stated to be 5·3 lbs. per indicated H.P. per hour. Reference was also made to Professor Rankine's experiments on board the *Admiral*, fitted with double cylinder engines, in which the consumption was said to be $2\frac{19}{20}$ lbs. per indicated H.P. per hour, or nearly 50 per cent. more than that of the *Kabyle*, as determined by M. Moreau. Also to some experiments on board the *Algesiras*, a French ship of the line, of 2,414 indicated H.P., when it was found that with the full pressure of the steam the consumption was 3·74 lbs. per indicated H.P. per hour, and with the steam cut off at one-third of the stroke, 3·6 lbs. per indicated H.P. per hour. The author believed that the ordinary cousumption of fuel in marine engines was above 6 lbs. per indicated H.P. per hour; that comparatively few worked so low as 5 lbs., and none under 4½ lbs., taking the gross consumption for a whole year.

An examination of the tabular records of the experiments made with the two ships *Sahel* and *Oasis*, gave the following results, in favour of the combined vapour-engines. First, a weight and space available for 50 additional tons of cargo, or an increase of one-sixth; secondly, a diminution in the consumption of fuel of 40 per cent.; and thirdly, an increase of one-ninth in the speed of the ship. The attendant disadvantages were,—the first cost of the apparatus, the difficulty of condensing the ether, during very hot weather, the losses arising from leaks, which occurred from time to time in the vapouriser, and the expense and danger of the liquid employed necessitating constant care, and a more efficient engineer than an ordinary steam-engine. Still, notwithstanding all these inconveniences, the actual saving was such as to merit attention. The additional expense required to fit the *Sahel* with a combined engine, instead of a common steam-engine, would not exceed £4,000. Such a ship on the African line could accomplish from twenty to twenty-four voyages per annum, or run from 20,000 to 24,000 miles, and economise, as compared to the *Oasis*, 1,000 tons of coal, of the value of £1,600. From this would have to be deducted the value of the ether consumed, say £409, and £400 as a sinking fund to pay off the extra expense incurred, or together £809; leaving a nett economy of £761. But to this must be added the profits arising from the additional cargo capable of being carried; this could not be estimated at less than £700, so that there resulted a nett economy of £1,491, a sum more than sufficient to pay an interest of 6 per cent. per annum on the capital required to purchase such a ship.

The number of accidents which had occurred during five years' experience had been but three. The first happened on board the ship *France*, when lying in the port of Messina. This arose from an escape of ether, caused by a workman having trodden upon and broken a weak copper pipe under the bilge water, and which was therefore out of sight. The ether having accumulated in the engine-room, was accidentally ignited, when a great flame filled the engine-room, and extinguished itself in a few moments, without producing any disorder, or leaving any trace of the fire. The second accident, which caused one death, occurred on board the ship *Brésil*, when in the dry dock at Marseilles. This accident was also occasioned by a workman entering the engine-room with a naked light, against express orders, and setting fire to the gases of the ether floating in the room, the vapouriser being open at the time for cleaning. The third accident was the most serious, and the most fatal to the development of the system: this was the burning of the ship *France*, in the port of Bahia, before alluded to. It was now well known that this had been caused by discharging at night a number of cases containing ether, not belonging to the provision of the ship. One of the cases was broken, the liquid spread, and ignited at one of the lanterns, setting fire to the hold, at some distance from the engine-room. Thus, these accidents all occurred when the engines were not at work, when the fires were extinguished, and the ships were in port. No accident had happened to the ships while at sea, and no extra insurance had ever been paid on the ships on account of their containing ether, even after the burning of the ship *France*.

In conclusion, it was remarked, that the difficulty of condensing the ether would not take place in latitudes where there was not an excessively high temperature, nor if a liquid with a higher point of ebullition was employed. The occasional leakage of the vapouriser was a purely practical defect, which would, no doubt, be easily remedied. As, therefore, a great economy of fuel had been shown to result from the combined system, it remained to be seen whether the inconveniences mentioned were such as to limit its general extension. It was thought possible that a cheap non-inflammable liquid might be discovered, and that the cost of the apparatus might be still further reduced; as experiments, made by Mr. Bramwell, seemed to lead to the belief that the surface of the vapouriser might be considerably decreased. The extensive scale on which the system had already been employed, and the favourable manner in which it had been reported upon by different engineers, was the Author's reason for bringing the subject under the notice of the members. M. Du Trembley was most anxious that his invention should be better known to English engineers, in the hope that they would co-operate in removing the existing defects, and in rendering its application more certain and practicable.

NOTICES TO CORRESPONDENTS.

J. M. L. (Newcastle).—We have in preparation something which will meet your views.

J. W. C. (Hotwells, Bristol).—We have answered your inquiry respecting the pumps, by post.

J. W. C. (Leeds).—The information shall be forwarded to you in due time—that is to say, the information you ask for.

R. Hayn (Grabow, near Stettin). — We have made inquiry, but regret that we are unable at present to obtain for you what you seek. Naval architects are plentiful, and many excellent draughtsmen are without employment; but we will not forget you should the opportunity occur.

W. L. (Rochdale).—We are unable to discover anything concerning the subject of your inquiry of the 15th ult.; but if you will forward the printed form of receipt given for your subscription, the plate, Number 120, shall be forwarded. Send your address.

J. K. (Clifton).—You shall hear in due time.

R.—Mr. Taylorson's address is Port Glasgow, Clyde. Mr. T. recently read a paper upon his diagonal system of ship-building, at the United Service Institution.

O. Dingler (Ars sur Moselle).—We have had the parcel returned to us, it having been refused by the French Post Office.

H. Wimshurt and others.—We are compelled to defer the publication of several letters until next month, when we will reserve space for them.

We must crave indulgence at the hands of very many of our correspondents whose communications remain unanswered, but we hope to be able to entirely clear off arrears in our next.

REVIEWS AND NOTICES OF NEW BOOKS.

Cours d'Astronomie, à l'Usage des Officiers de la Marine Impériale. Par E. P. Dubois. Paris: Arthus Bertrand, Editeur, Libraire de la Société de Géographie, Rue Hautefeuille, 21.

This work, intended for the use of officers in the Imperial French navy, is one of the ablest treatises on astronomy which has been published for many years; for whilst the subject is treated throughout in a thoroughly scientific manner with great ability, there is so much of the popular style of teaching retained as to render it not only a valuable, but also an easy study-book.

One of the features of this work which recommends it particularly to the attention of the student in science, is the admirable portion of the work devoted to descriptions of the various instruments employed for astronomical purposes.

The Construction of Wrought-Iron Bridges, embracing the Practical Application of the Principles of Mechanics to Wrought-Iron Girder Work. By John Herbert Latham, M.A., Civil Engineer, Fellow of Class College, Cambridge. Macmillan and Co., Cambridge, and Henrietta Street, London. 1858.

We are sorry that we have not been able to devote that amount of time and attention to the perusal of Mr. Latham's work, since it was forwarded to us so recently, as to enable us to do justice to it in our columns for the present month. Suffice it, however, to state, that the author, in addition to possessing high mathematical attainments, has had practical experience in determining the correct proportions of girder bridges, and such-like structures, for the late Mr. Rendel, M.I.C.E.; and the author, in his preface, laments the broad chasm existing between theoretical writing and practical mechanica lexperience, and he adds,—

"Of late years the properties of iron have become more and more known and defined; and the resources and accuracy of our workmanship render a very close analysis of the strains upon a structure capable of being carried out both *soundly* and *economically*. It is therefore especially satisfactory to see the chasm between the literature of our highest experience and highest reasoning really closing. But how great a gap still exists between the abstract theorems and rudimentary figures in the highest mathematical books of our universities and elsewhere, and the explanations of our practice, the elaborated repetition of experiments, and expensive plates in the most practical engineering books! The object of the present treatise is to exhibit the application of mechanical theory, in *as simple working forms* as possible, to those points of girder-work in which that application is proved *practically* valuable."

In the hasty glance which alone we have been able to afford to the present volume, we are enabled to judge of the amount of valuable analytical knowledge which Mr. Latham has, in addition to his mathematical acquirements, brought to bear upon the subject under treatment; and we hope, at some very early date, to be able to cite some passages as examples, and to contrast them with the views and writings of some of the authors who have preceded him in the treatment of the same subject.

Miscellaneous Papers on Mechanical Subjects. By Joseph Whitworth, F.R.S. London: Longmans'; Manchester: J. and J. Thompson.

The high reputation of Mr. Whitworth as a mechanician of the first order is a guarantee for the sound and practical character of the work which he has modestly published under the above title; for, although the volume is made up of a number of papers upon various subjects—connected with mechanical engineering particularly and mechanical science generally—some of the papers possess merit and matter sufficient to form the text for even a larger volume than that now before us; and, in the hands of an enterprising *book-maker*, there is no doubt that the matter contained in the 175 pages would have been spread over or diffused through very many times more than that number of pages. The student in mechanical science and the practical mechanic will each find much that is very useful to them in Mr. Whitworth's volume of miscellaneous papers on mechanical subjects.

Adcock's Engineers' Pocket Book for the year 1859. London: Simpkin, Marshall, and Co.

Numerous improvements have been effected in this useful companion to the engineer since we last noticed it; and we are glad to perceive that the original character of a pocket-book is maintained by the retention of the portion devoted to the diary and cash-account.

Description of Griffiths' Patent Screw-Propeller. London: M. Soul. 1858.

Mr. Griffiths' screw-propeller is so well known to most of our readers, and the advantages possessed by his construction of propeller over various other forms now so generally admitted, that it is unnecessary for us to do more than state that the Author, in the pamphlet before us, describes his invention and its advantages minutely, and illustrates it with a sheet of copper-plate engravings of his Improved Patent Screw-Propeller; and he adds a number of certificates and testimonials, each speaking to the advantage of employing Griffiths' propeller.

Recent Practice in the Locomotive Engine. By D. K. Clark and Z. Colburn. Blackie and Son. 1859.

THE new part just issued maintains the reputation of the authors. The excellencies of the new series of Railway Machinery, referred to in our previous notices, are fully justified by the further issue which is now before us.

The Carpenter and Joiner's Assistant. Blackie and Son. Parts 15 and 16.

THIS very excellently illustrated series of examples relating to Constructive Joinery, and the excellent textual matter accompanying the same, exceeds in practical usefulness any work hitherto published purporting to treat of the same subjects. The selection of illustrations is only equalled by the admirable manner in which they are produced.

LIST OF NEW BOOKS AND NEW EDITIONS OF BOOKS.

BAKER (T.)—Elements of Mechanism, explaining the Practical Constructions of Machines for the nse of Students in Engineering (Illustrated). 2nd edit., with remarks by Nasmyth, 12mo, cloth, 2s. 6d. (Weale.)

BAKEWELL (F. C.)—A Popular History and Description of the most Remarkable Inventions during the present Century. Post 8vo, pp. 310, cloth, 3s. 6d. (Houlston.)

DOUGLAS (H.)—On Naval Warfare, with Steam. By Gen. Sir Howard Douglas. 8vo, pp. 170, cloth, 8s. 6d. (Murray.)

CONNINGTON (E. T.)—A Handbook of Chemical Analysis (adapted to the unitary notation), 4th edit., 7s. 6d.: also Tables of Qualitative Analysis to accompany the Handbook, 2s. 6d. (Longman.)

LIEBIG (J.)—Letters on Chemistry, in its relations to Physiology, Dietetics, Agriculture, Commerce, and Political Economy. 4th edit., revised by John Blyth. 8vo, pp. 563, cloth, 7s. 6d. (Walton.)

LAYTON (W.)—Builders' Price-book for 1859: containing about 20,000 prices, corrected according to the present state of materials and labour. Cloth, 4s. (Knott.)

MOORE (A.)—Handbook of Railway Law, containing the Public Railway Acts from 1838 to 1858, with Introdnction, containing Statistical and Financial Information, Notes, Forms, &c.; and Analytical Index, pp. 520. Cloth, 10s. 6d. (W. H. Smith.)

NAUTICAL MAGAZINE for 1858,—On subjects connected with maritime affairs. 8vo, pp. 700. 13s. 6d. (Simpkin.)

HOW TO FORTIFY LONDON AND NULLIFY CHERBOURG.—12mo, 1s. (Freeman.)

LUMLEY (W. G.)—The New Sanitary Laws: that is, The Public Health Act, 1848 and 1858; and other various statutes connected therewith. 12mo, pp. 566, cloth, 10s. (Shaw.)

HEADLEY (O. D.)—Who Invented the Locomotive Engine? with a Review of "Smiles' Life of Stephenson." 8vo, cloth, 4s. 6d. (Ward and Lock.)

MURCHISON (R. I.)—Siluria: the History of the oldest Fossiliferous Rocks and their foundation; with a sketch of the distribution of Gold over the Earth, 3rd edit., cloth, 42s. (Murray.)

DOWSING (W.)—The Timber Merchant and Builder's Companion; Weights and Measures of Deals from one to a thousand pieces, with relative price each size bears per lineal foot to any given price per Petersburg hundred; and other information in buying and selling foreign timber. (Simpkin.)

FARADAY (M.)—Researches in Chemistry and Physics. 8vo, pp. 500, cloth, 15s. (Taylor and Francis.)

RAWLINSON (R.)—Designs for Factory, Furnace, and other tall Chimney Shafts. Cloth, £3 3s. (Weale.)

WHITWORTH (I.)—Miscellaneons papers on Mechanical snbjects. 8vo, pp. 188, cloth, 5s. (Longman.)

WILSON (G.)—Electricity and the Electric Telegraph; to which is added the Chemistry of the Stars. (Traveller's Library), 12mo, 1s. (Longman.)

WILSON (G.)—The Progress of the Telegraph, sewed, 1s. (McMillan.)

CORRESPONDENCE.

[*We do not hold ourselves responsible for the opinions of our Correspondents.*]—ED.

To the Editor of The Artizan.

SIR,—Trusting to your well-known willingness to record improvements tending to economy of fuel in steam engines, I beg to enclose herewith a tabular statement of the performance of a small screw steamship, fitted by me in 1857 with a new boiler and improved surface-condenser.

The arrangements introduced were far from what I consider complete, in consequence of original defects in the construction of the engines,—and every engineer knows the difficulty of making a patched job perfectly satisfactory. I was also required to leave the ordinary injection-condenser and air-pump undisturbed, so that if my arrangements failed recourse could be had to the old system; this obliged me to cut contracted additional exhaust outlets on each cylinder.

I mention these circumstances, as they must influence the result, and therefore be allowed as reasons why the economy was not greater.

If I had had the means of fitting an air-pump of the usual capacity, the vacuum would have averaged 27 to 28 in. This, however, could not be conveniently done; the present air-pump is horizontal, single-acting, attached directly to the engines, and is only *one-third* of the usual capacity for engines of 50 H.P. nominal, or 190 H.P. indicated.

There are two cylinders direct acting, each 18 in. diameter, and 21 in. stroke. The steam is admitted for 4-10ths of the stroke, and cut off by separate expansive valves.

The boiler is cylindrical, has 1,000 sq. ft. of heating surface, and 33 sq. ft. of fire grate.

The surface, in the surface-condenser, is between one-third and one-half of the heating surface of boiler, and occupies about 1-20th of boiler space.

The indicated power was calculated from some forty diagrams taken at sea in regular work; and it is not difficult for any engineer to check the actual power, as all the chief particulars are accurately given in this letter and the statement.

It will be seen the average consumption of coal per indicated H.P. per hour is 2,063 lbs.; and I think you will admit this is an economical result, especially when we consider this vessel was not fitted by our friends on the Clyde.

I only claim for this result, the credit fairly due to success in economising fuel to a *certain extent*. But with *new* engines, I can insure any shipowner an *average consumption of* $1\frac{1}{2}$ *lbs. of coal per indicated H.P. per hour*; that is 100 H.P. engines, indicating four times, or 400 indicated H.P. will require from 5 to 6 cwt. per hour.

I am aware there are at the present time many engineers directing their attention to the economy of fuel in marine-engines, and I heartily wish them success. There is no reason why jealousy should prevent a free exchange of opinion, and I give simply the result of my own experience.

I am, Sir, yours obediently,
J. FREDERICK SPENCER.

Adelaide Place, London Bridge, 12th February, 1859.

P.S. The owner of the *Alar*, Mr. H. P. Maples, of Arthur-street East, will I am sure bear testimony to the correctness of these statements.

P.P.S.—It must not be forgotten that the above statements are the results of twelve months regular work, and not of mere trial-trips; and that the distance traversed is about equal to a voyage to Australia and back.

IRON SCREW STEAMSHIP "ALAR," 50 H.P.

Average Indicated H.P. 190.—Engines fitted with J. F. SPENCER'S Fresh Water Arrangements.

ABSTRACT STATEMENT OF VOYAGES BETWEEN THE PORTS OF SHOREHAM, SUSSEX, AND ST. HELIER'S, JERSEY.

Month.	Year.	Totals.					Averages.									Quality of Coal.
		No. of Sailings.	Time running under Steam.	Running Distance.	Total Coal Consumption.	Running Coal Consumption.	Gauges. Steam.	Gauges. Vacuum.	Revolutions.	Speed per Hour.	Time of each Passage.	Coal consumed each Passage.	Running Coal consumption each Passage.	Running Coal consumption per Hour.	
		No.	Hrs. Ms.	Knots.	Tons.	Tons.	Lbs.	Lbs.	No.	Knots.	Hrs. Ms.	Tons.	Tons.	Cwts.	
November	1857	8	148·25	1,310	30·5	26·5	39·	12·06	107	8·82	18·33	3·8	3·31	3·57	Nixon's Duffryn
December	,,	9	186·40	1,560	32·5	28·	37·4	12·	105	8·36	20·44	3·6	3·11	3·	
January	1858	9	139·55	1,360	28·	23·5	40·	12·06	108	9·75	15·32	3·11	2·61	3·35	
February	,,	8	127·55	1,200	24·	20·	38·3	12·	106	9·37	16·	3·	2·5	3·13	
March........	,,	9	144·35	1,400	28·5	24·	38·5	12·	108	9·7	16·	3·16	2·66	3·32	
April	,,	9	179·40	1,510	33·5	29·	39·	12·	110	8·4	19·57	3·7	3·22	3·23	
May..........	,,	14	231·32	2,170	48·5	41·5	37·8	12·2	108	9·37	16·32	3·46	2·94	3·58	
June	,,	17	274·13	2,570	53·5	45·	36·7	12·3	110	9·38	16·8	3·14	2·64	3·28	
July..........	,,	18	284·55	2,740	65·5	56·5	35·	12·3	108	9·61	15·40	3·64	3·14	3·96	Llanelly
August	,,	17	281·25	2,590	62·5	54·	33·	12·1	105	9·2	16·40	3·67	3·17	3·84	
September	,,	17	281·5	2,620	62·	53·5	37·	12·1	106	9·32	16·39	3·65	3·15	3·8	
October	,,	16	299·45	2,630	66·5	58·5	35·5	12·1	105	8·77	18·44	4·15	3·65	3·93	West Hartley
Summary..	..	151	2580·5	23,660	535·5	460.	37·26	12·1	107·16	9·17	17·15	$3\frac{1}{2}$	3	$3\frac{1}{2}$	

N.B.—The information given above is carefully compiled from the Captain and Engineer's Logs, and the coal also checked by the total quantity supplied.

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c.

Under this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.—Ed.

Masters and Workmen.—Inefficient Machinery.—A case of some importance, as involving the liability of employers in cases of accidents arising from defective machinery, &c., was heard (22nd January ult.) before Sheriff Strathern, in the Glasgow Small Debt Court. The plaintiff, a "shanker," claimed damages for personal injuries received by him on the 15th December ult. in the "Breaky" Sinking Pit, near Plains, for which defendant was contractor. Whilst in the latter's employment as a "shanker," a wire connected with the clag-door "having broken, and occasioned the plaintiff's fall to the bottom of the pit, whereby he was seriously injured, and rendered unable to work for several weeks." The sheriff decided that the law was quite clear that *masters were bound to have sufficient machinery* supplied to their workmen; that it was held in the case of Buist and Co., the fact of machinery giving way is *primâ facie* evidence of deficiency; and that the defender (defendant), to elude liability, was bound to have proved its efficiency, particularly in the present instance, where it was in evidence that, prior to the day of the accident, several complaints had been made by the workmen about the wire in question; some of them having left the work because no redress had been accorded to them. Alluding to the fact, also proved, that, in other sinking-pits, wire is not used, but a chain or "muzzle," he the sheriff, wished it to be particularly understood, that if, from a parsimonious view, masters hesitated to furnish suitable and proper appliance, their plea of non-liability will not avail them. Decree for plaintiff—£5 damages, with expenses.

Parchment or Paper?—A special case, on an information filed by the Attorney-General against Mr. Barry, to recover penalties for carrying on business as a paper-maker at Abbey Mills, Brompton, was argued in the Court of Exchequer, 27th January ult. The question being, whether the article manufactured by defendant was liable to duty as paper. At the trial, a verdict had been entered for the Crown, subject to the opinion of the Court of Exchequer, whether the material was to be regarded as paper or parchment? For the Crown it was contended that the article was paper, within the meaning of the Act of Parliament; and, as such, liable to duty. For the defendant it was urged that it was not paper, because it was manufactured of animal, and not of vegetable matter: that its appearance was different from, and it was applied to different purposes than paper; and, further, that if it were liable to duty at all, it was only liable to the lesser duty on parchment. The invention, for which letters-patent were granted to Mr. John Harcourt Brown, of Arthur's Seat, Aberdeen, was for "Improvements in the manufacture of artificial skins," the object being to produce artificial skins for the manufacture of parchment or such like articles, and leather; and consists in employing the cuttings or other parts of hides and skins, by reducing the same to pulp; and, then, by rollers or pressure, to produce sheets.

Designs Registration Act.—The "Druid" Mantle.—A mantle-manufacturer of Oxford Street, was (5th February ult.) summoned before Mr. Bingham, at Marlborough Street Police Office, "for exposing for sale an article of manufacture of which another in the trade was the registered proprietor, and the design of which was registered in pursuance of the Designs Copyright Act 5 and 6 Vict. c. 100, and numbered 114, 231, after being served with notice by such registered proprietor, that his consent had not been given, &c." Proof of service of such notice, and the certificate of registration, proof of identity with registered pattern, &c., having been put in, the magistrate, under the circumstances urged by the defendant in explanation—(namely, that he had bought the original at another establishment, and that if he was a copyist, it was not from the [registered] original)—inflicted a fine of 1s., and the costs, £7. Another "Mantle Firm" were (same day) also summoned by the same registered proprietor, under precisely similar circumstances. In this case it was ultimately arranged that each defendant should pay 1s. and costs, fixed at £4 in each case.

The Sardinia and Algeria Submarine Cable has become the subject of litigation abroad and at home. The Mediterranean Submarine Telegraph Company, represented by Mr. Brett, some time since entered, it appears, into a contract with Messrs. Newall and Co., for laying down this cable; the contract stipulating that in case of any dissension arising, arbitrators should be chosen by a court of law, their decision to be final. When the cable was delivered, the Company refused to receive it, on the ground that only one of the four wires]was capable of transmitting despatches perfectly. The contractors, on the other hand, maintained that all the four wires were perfect. An arbitration therefore became necessary; but whilst the company insisted that it should take place in France, Messrs. Newall and Co. required it to be in England. Recently the company applied to the Civil Tribunal to order the nomination of experts. Messrs. Newall raised the objection that the tribunal had no jurisdiction, inasmuch as the agreement was made in England, between Englishmen, that the conditions indicated that the parties had intended to have recourse to English Courts, and that they (Newall and Co.) had in consequence commenced legal proceeding in England, to which Brett had put in an appearance. The Tribunal, however, decided that as the company was a French one, and had its office in Paris, the French courts had full jurisdiction; and it ordered the case to be gone into on the merits in a fortnight.

Threshing Machines—Damages for Non-delivery.—In the Court of Queen's Bench (31st January ult.), Mr. Justice Crompton, by consent, fixed at £300 the amount of damages to be assessed in an action (Sneed *v.* Ford) brought by a farmer for loss, &c., arising from the non-delivery of a threshing-machine according to contract. The question raised had been, whether the plaintiff could recover as damages the injury which his corn had sustained by lying on the land, and the expense of kiln-drying it afterwards; it being intimated to the defendant at the time the machine was ordered, that if it was not delivered by the stipulated day,—the 14th of August—the defendant would be under the necessity of hiring one. For defendant it was contended, that the proper measure of the damages was the cost of hiring another machine. Lord Campbell, on the argument of the rule to enter the verdict for merely nominal damages, held that the plaintiff was entitled to recover damages for what were the natural consequences of the defendant's breach of contract, and which were in the contemplation of the parties at the time of the contract. It did not appear that the plaintiff could have hired another machine; and besides, the defendant had induced him to wait from time to time, in expectation of the arrival of his machine. The damage done to the wheat, and the cost of drying it, were the natural consequences of the defendant's breach of contract, and the proper measure of damages. It was ultimately arranged that Mr. Justice Crompton should fix the amount of damages to be assesssd on this principle. The result we have given above. Rule accordingly.

The Liverpool Waterworks.—In the Bail Court (Sittings in Banco, before Mr. Justice Erle), 31st January ult., a satisfactory adjustment of this dispute was effected. An indictment had been preferred against the Corporation of Liverpool for improperly interfering with a public highway in the construction of their waterworks, and not making a proper road in lieu thereof. The defendants had been convicted, and a rule had been obtained ordering them to pay a large fine, with a view of compelling them to make a new and sufficient road. The matter had been referred; and the referee now stated that a road had now been made to his satisfaction. The prosecutors therefore consented that the rule being made absolute, a nominal fine only (viz., of one shilling) should be imposed. Rule absolute accordingly.

Are Locomotives, propelled by steam or other mechanical power, on a particular road, in legal sense,—a "nuisance"? This question will shortly have to be decided, as in a recent case, in V. C. Sir W. P. Wood's Court—(Attorney General *v.* the South Yorkshire Railway and River Dun Navigation Company), an injunction was granted (26th January ult.), "upon the undertaking of the relators" (in this information) "to prefer any indictment against the defendants at the next assizes—to restrain the defendants from running locomotive engines propelled by steam or other mechanical power across the South Parade (in Thorne): the defendants to admit upon the trial of the indictment, that they have run locomotive-engines across the South Parade for the ordinary purposes of their traffic."

Glazing Woollens, &c.—Question of Infringement of Patent.—An appeal case (Brook and another *v.* Alton) in error, from the Court of Queen's Bench was (1st February ult.), argued before the Lord C. J. and a full court. The plaintiff relied on his patent for the manufacture of woollen fabrics and finishing woollen yarn or hair by perpendicular friction and rotatory motion, and beating, which produces a glassy appearance on woollen threads. The defendant opposed the patent on the ground that he had previously obtained a patent for manufacturing cotton and linen yarn by a glutinous solution, which produced the same glassy appearance in cotton, thread, and fabrics manufactured as in the plaintiff's patent. At the trial the jury found a verdict for the plaintiff: but the Court of Queen's Bench had entered the verdict for the defendant. The Court (1st February ult.) affirmed the decision of the Court below.

Rateability of Docks to relief of the poor. In a recent case argued in the Court of Queen's Bench (the Queen on the prosecution of the churchwardens and overseers of Churton *v.* the Tyne Improvement Commissioners), the question raised was, whether the Northumberland docks, in the River Tyne, were liable to be rated to the relief of the poor. On the part of the commissioners it was contended that they were exempt, from rateability on the ground that they had no beneficial occupation, the whole of what they received in dues being applicable to public purposes; on the other hand, the respondent parish relied on the decision in the Birkenhead Dock case. Lord Campbell thought that the dock rates in question were not applied to a public purpose, such as the post-office, or anything done under the Government of the country; and that the case was that of the Birkenhead Docks, to the principle of which case he thought the court ought strictly to adhere. The other judges being of the same opinion, judgment was given for the respondent parish.

Canal Navigation.—Expense of Locks.—Question of Rates.—In another case (the Queen *v.* the Coventry Canal Navigation Company), argued in the Queen's Bench, 31st January ult., the question was whether the expense of maintaining two locks, in the respondent (rating) parish, amounting to £105, was to be deducted from the gross earnings (£185) by the canals in that parish, in ascertaining the rateable value; or whether that expense ought to be thrown upon the whole line of the canal. Lord Campbell's judgment, and that of the Court, was in favour of the latter view. He also observed, that there was considerable difficulty in applying the rule laid down in the Parochial Assessment Act to canals and railways, passing through many parishes, a species of property rapidly increasing in amount, which did not seem to have been in contemplation when the act passed. The difficulty, indeed, called for the interference of the legislature. Reverting to the present case, he saw no difficulty in applying similar rules of rating "whether the companies were carriers themselves, or received their profits in the shape of tolls for using the means of conveyance which they furnished to the public, without furnishing the vehicles to convey, or the moving power." Judgment for the respondents (the parish).

Winnowing and Dressing Machines.—Question of Infringement of Patent.—In the Queen's Bench (sittings at Nisi Prius, Westminster, before Lord Campbell and a special jury, 3rd February ult.) an action—Nalder *v.* Clayton—was tried, involving the question whether the defendant had infringed the plaintiff's patent for certain machines for winnowing and dressing grain.—Adjourned.

Liability of Engine Drivers.—At the High Court of Justiciary, Edinburgh, 7th February ult., an engine-driver on the North British Railway, was charged with "culpable homicide" (manslaughter) and "culpable violation, or neglect of duty." On the evening of the 20th October last, accused was driving a special goods'-train from Edinburgh to Galashiels, and at Heriot station his train ran into a cattle-train, which was some minutes in advance, whereby the guards' van, attached to the cattle-train, was broken in pieces; and the drover, who was travelling in the van, was thrown out and so injured that he died the next day, and another drover severely bruised. It was also proved that the signal to stop was duly exhibited from the distance-post, and that accused was aware of the cattle-train being immediately in advance of the goods'-train. Defence, that, owing to existence of fog, the Heriot signal-light could not be seen from the usual place; and that, immediately seeing the signal, he used every means in his power to bring his train to a stop; that no fog-signals were used to give him intimation that the line was obstructed, &c. The jury, by a majority, found him "guilty," but strongly recommended him to the leniency of the Court, owing to the extenuating circumstances in the case. The Lord Justice Clerk, in passing sentence of six months' imprisonment, remaked that the accident had arisen from the prisoner's violation of the regulations that had been issued for his guidance,* and that he hoped the occurrence would be a warning to him, not from any ideas of his own, or any calculations of chances or probabilities, to disregard the specific and imperative injunctions laid upon him.

[*Note.*—The manager of the railway had been called to prove that, according to the regulations of the Company, it was prisoner's duty in dark and foggy weather to have a head-lamp attached to the engine, to move with great caution and slowness, and, on approaching a station, whether the danger-signal was on or not, to bring his train so under control that, on seeing the signal, he might be able to bring it up.]

Railway Coal-Traffic.—Side Stations.—In the case of the Rhymney Railway Company *v.* the Taff Vale Railway Company—Court of Common Pleas, 31st January ult.—cause was shown against a rule for an injunction, under the Railway and Canal Traffic Act, enjoining the defendants to afford to the plaintiffs due and reasonable facilities for carrying, forwarding, and delivering their coal traffic at the junction, by making a proper side station there. At the suggestion of the Chief Justice, it was ordered to be referred to some competent engineer to decide what was requisite, and what ought to be done to accommodate the traffic, which, in the article of coals, was said to be very great.

Compensation for Railway Injuries.—In the Court of Exchequer (3rd February ult.), the plaintiff (Mr. Wood, a boot and shoe maker) recovered £475 damages against the London and North-Western Railway Company for injuries received by reason of a coal-train running into a passenger-train, by which plaintiff was travelling, whereby his head was severely injured, and other physical hurts inflicted. Plaintiff likewise claimed compensation for consequent loss in his business. The Company, in this case, admitted their liability, refraining from offering any adverse evidence; thus leaving the amount of damages as the only question for the consideration of the jury.

In another Action for Railway Injuries (Gayler *v.* the Eastern Counties Railway), tried in the Court of Exchequer, 2nd February ult., the plaintiff recovered £400 damages for injuries to the spine, sustained on 12th September last, by reason of the train in which plaintiff (who is shopman to a cheesemonger) was a third-class passenger, running into a truck at Tottenham, where the truck, by the force of the collision, was thrown up, falling across the rail which divides the compartments of the third-class carriages, and injuring plaintiff's back. In this case the facts were admitted, and the sole question was as to the amount of compensation.

Steam Printing-machines.—Legal Decisions.—In the Common Pleas (7th February ult.) an action (Turnbull and another *v.* Tallis,) was brought by plaintiffs, lodging-house keepers in Arundel Street, Strand, against the printer of the "Illustrated News of the World," "Daily Telegraph," &c., for a nuisance caused by the working of a steam and printing-machine belonging to the defendant. The press, in question, was one of Hoe's American Machines, of great power; and being placed on the ground floor instead of on the basement, was alleged to cause such amount of vibration as to endanger plaintiff's premises, and, further, "that no one could sleep in the house" in consequence of the incessant rumbling caused by the engine, &c. These allegations being in great measure denied, on behalf of the plaintiff, a somewhat curious incident occurred—the Lord Chief Justice suggesting that some of the jury should visit the premises, and sleep there. On the 8th February ult., the hearing of the case being resumed, three of the jury said they had visited the premises as his lordship had suggested, and two of them stated that they did not find any extraordinary vibration or annoyance from the noise of the machine. On the other hand, the third juryman was of opinion that there was great vibration; and that the noise from the machine and engine was an intolerable nuisance. It was, finally, agreed that a nominal verdict should pass for the plaintiff for 40s.; defendant undertaking to adopt such measures as might be suggested by a competent person, to whom the matter should be referred, to put an end, as far as possible, to the inconvenience complained of.

Railway Damages.—In the Court of Exchequer (10th February ult.), Bowling *v.* The South Eastern Railway Company. The plaintiff, who is high bailiff of a County Court in Kent, brought his action for injuries received by him on the 9th of August last, when on the train approaching Ramsgate, a sudden squall of wind arose, and catching the train, it was driven into the station, the buffers striking the wall and causing a violent shock, by which many of the passengers suffered contusions; plaintiff was thrown violently forward and much bruised. The defendants paid £5 into Court. The Lord Chief Baron, in summing up, laid it down as law, in reference to some observations made by plaintiff's counsel, that, although in estimating damages the station in life and the age of the plaintiff might properly be taken into account, the jury had nothing to do with the question whether a man was a bachelor, or a married man, or a widower, and whether he had nine children or none. Verdict for plaintiff—damages, £50.

Steamer Collisions.—In the Judicial Committee of the Privy Council (10th February ult.), an appeal against a decision of the High Court of Admiralty (Gisbone, appellant, *v.* the Anglo-French Steamship Company) was heard, and decided against the appellant. The collision occurred on the 15th April last (9.30 p.m.) off Yarmouth, about 6 miles southward of the Newark light vessel, between the Prussian ship *Thomas*, and the British screw-ship *Ernestine*, of which respondents—the Anglo-French Steam Company—were owners. The result was that the *Ernestine* foundered. It was submitted, on behalf of appellants, that if the *Ernestine* had kept the course she was steering, when her lights were first seen by the *Thomas*, she would have passed on the port side of the *Thomas*, whether the helm of the latter was ported or not. Further, that the collision was occasioned by those on board the *Ernestine* having starboarded, instead of keeping their course, or ported their helm. For respondents, it was contended that no blame could be attached to them; and that the collision was attributable to the appellants—the ship *Thomas*. Their lordships were of opinion that the *Thomas* had contributed to the accident by porting her helm, and was in fault. They therefore dismissed the appeal, with costs.

Calender Machine.—In the Court of Common Pleas (14th February ult.), the plaintiff (Everhard) sued Messrs. Sawyer and Strange for £45, the price of a "calender" supplied to them for the purpose of mangling, in a superior manner, the table-linen used by them at the Crystal Palace. Plaintiff is an engineer and millwright in Bethnal Green, and agreed to supply the machine for £45,—made it, and set it to work. A tooth of a cog-wheel was broken in the fixing, but a new wheel was afterwards supplied, and the machine worked well. For the defence, it was stated that there were several defects in the machine, such as the broken cog, and an iron cylinder not having been properly bored. The principal complaint, however, was, that a wooden roller had patches fastened on it by wooden pegs, and had cracks in it which rendered it unfit for its purpose, and which cut the cloth. The roller also was so heavy that it could not practically be worked, and only a few cloths had ever been passed through. Some of these were produced in Court for inspection by the jury, as was also the roller. There was scientific evidence to the effect that the machine was not efficient. The jury found a verdict for the defendants.

Liability of Railway "Gangers."—Neglect to post Signals.—On the 14th February ult., at Bath, a "ganger," employed on the Great Western Railway, was, at the instance of the Directors, fined £2, by the magistrates, at the Guildhall, in that City, for having, in disobedience to orders, on the Saturday preceding, placed what is called a "trolley," loaded with ballast, upon the line, at Sydney Gardens, without sending a signal-man back a mile with a red flag, the consequence of which was, that the down goods train ran into the "trolley" and smashed it to pieces.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

We have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "18, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

Mr. W. G. Armstrong, C.E., of Newcastle-on-Tyne, the celebrated mechanical engineer, and inventor of the rifled cannon, which has recently performed so satisfactorily, propelling very heavy shot, with the highest attainable accuracy, at enormously long ranges, has just been knighted by Her Majesty (24th February), and is therefore now Sir W. G. Armstrong, C.E., &c., &c.

The Smoke Nuisance—[Asphalte.]—At the Glasgow Western Police Court (19th January ult.), an asphalte manufacturer was fined 20s. for having, the previous day, allowed a quantity of smoke to escape from one of his machines.

Tramways in Ireland are, in all probability, about to be constructed on a national scale, and with the sanction of the Legislature, as a means of facilitating internal communication, a Bill for that purpose having been brought into the House of Commons, whereby persons are to be authorised to promote tramway companies, to subscribe capital therefor, and when half the cost has been subscribed, to apply for leave to construct works; also to memorialise grand juries on the subject.

The Shipping Losses of France, sustained in 1858 (by shipwreck, fire, collisions, and other causes), amounted to 444 vessels, of which 103 were engaged in long voyages—the remainder in the shipping trade. Total loss (according to the *Débats*), during the last seven years, amounts to 2,973 vessels, of which 126 have never been heard of.

The Navy Estimates for the Year 1859-60 (issued 14th February ult.) present a net increase, as compared with last year, of £961,810. Total sum required, £8,259,299, against, for last financial year, £7,106,181.

The New Crane, recently erected at the Glasgow Steamboat Wharf, was recently officially tested in presence of Bailie Gray and the master of works, with a weight of 12 tons of pig iron. After the iron was about 3 ft. off the ground, and just as it was about to be turned round, one of the links in the chain snapped, and, says the "Glasgow Advertiser," down came the mass of metal to the ground, but without doing any injury.

The Victoria Revenue Estimate for the present year is composed of the following items:—

	£	s.	d.
Customs	1,777,000	0	0
Gold (Licenses, &c.)	60,000	0	0
Ports and Harbours	26,000	0	0
Proceeds of Sale of Crown Lands	750,000	0	0
Licenses (viz., Assessment on Stock, Debentures, Licenses, ditto to Publicans, Spirit Merchants, and Brewers)	342,000	0	0
Postage	97,000	0	0
Fees	59,000	0	0
Fines, &c.	15,000	0	0
Miscellaneous (formed principally of Taxes on the Chinese of £58,000; Railway Income and Water-rate, 125,000; Electric Telegraph, £18,500, &c.)	258,000	0	0
	£3,384,000	0	0

The Largest Mast-piece of Timber ever, perhaps, imported has arrived in the Commercial Docks, Rotherhithe. This mast contains 28 loads, weighing about 33 tons, is nearly as straight as a ruler, and without a knot, being 139½ ft. long, and 39½ in. square. When felled it measured 316 ft. to the branching top; and for 150 ft. was without any branch at all. It was squared to 41 in., but reduced to 31½ in. to admit of its entering the ships bowport. As regards quantity, it would give 3,502 cubic ft., or 70 loads 2 ft. as squared: or 116 loads as round timber. It would saw into 2,050 boards 41 in. wide ½ in. thick, and 12 ft. long. If laid out quite close, it would cover 72,000 square yards, or 1 acre 1 rood 2 chains 6 poles 10 yards, or about 2¾ acres. As a tree, it must have stood half as high again as the monument before it branched out. This mast, it is said, is destined to be raised as a flag-staff at Windsor.

The Duty on Paper, in the year ending 31st March last year, amounted to £1,130,698, against in preceding year, £1,138,880.

The extensive Tar Refiners' Premises of Messrs. Potter, Burt, and Co., Millwall, were (between 4 and 5 o'clock a.m., 4th February ult. (almost totally destroyed by fire. Cause unknown.

The extensive Ropery of Messrs. Glaholm and Robson, in Hendon-road, near Sunderland, have also been destroyed by fire. The whole of the works, engines, engine-house, factory, roving and spinning machines, warping, winding, and twisting machines, destroyed. Walls and all the substantial portions of the very extensive buildings a complete wreck, and mass of *debris*.

The Patent Waterpoof [Leather-cloth] Factory of Messrs. Spill and Co., on Stepney-green, was (25th January ult.) destroyed by fire. The building, over 100 ft. long, was burned to the ground; and the drying-room, vast stock of leather-cloth, machinery, &c., severely damaged.

The National Patent Steam-fuel Company's contributories were, by decree of Vice-Chancellor Kindersley, called upon to pay £1 15s. per share on the 10th February, 1859.

The Official Value of the Imports of France during the thirty years preceding and up to 1856, amounts, according to the recent returns of the Commissioners of Customs, just published, to 32,235,000,000f.; and the exports to 33,908,000,000f.

The Card-board from Wood ["Carton Bois"] Company, started in 1855, with a nominal capital of three millions of francs, 86,000 only of which was subsequently paid up, are in progress of "*liquidation*"—winding-up. A recent meeting of the shareholders approved the report of the liquidators appointed; from which it appears that the losses have exceeded the capital, receipts, &c., by 27,707f., and that an unsuccessful attempt had been made to dispose of the company's works by public auction at the upset price of 60,000f., subsequently reduced to 10,000f., at which reduction, however, no purchaser was found.

Exports in 1858.—The Board of Trade returns for the past year, issued 19th February ult., show the declared value of the exports of the produce of the United Kingdom to have been £116,614,331, or £5,451,776 less than those of 1857.

In the Shipment of Iron and Steel (last year) there has been a falling-off to the extent of £2,270,031.

In Woollen, Silks and Hardware, a decrease respectively of £925,398, £793,238 and £735,764.

In Machinery, a decrease of £279,680.

Bray's Traction-Engines, now constructing by Messrs. F. and J. Hughes, at their factory at New Cross, for service at the dockyards of Woolwich and Keyham were, 16th February ult., by leave of the authorities, inspected by M. Vianson, inspector of steam machinery, in the service of H.M. the King of Sardinia.

Total Accidents from Factory Machinery (Factory Inspector's reports for the half-year ending 31st October, 1858, just published (19th February ult.)—880 to males, 922 to females; total 1,802—of which 31 were fatal.

Informations laid for Breaches of the Factory Acts (in same period) 522, of which 182 withdrawn on payment of costs, and 340 followed by convictions. Total amount of fines inflicted, £476 5s.; of costs, £233 1s. 6d.

The Shipping of the United Kingdom in 1858, according to the return printed 19th February, ult., of the number of ships employed in the trade of the United Kingdom (i.e. "in trading in, from, and to Great Britain and Ireland"), last year, consisted of 19,209 sailing-vessels of 3,956,038, tons, against 18,429, in 1857. Steamers (in 1858), 862, of 369,204 tons against (in 1857) 899 ditto.

Rodger's Patent Small Pea Anchor.—A gratuity of 500*l.* is to be voted to Commander Wm. Rodger, on account of this invention, which is now generally used in the navy.

Lowering Ships' Boats.—Mr. Clifford, the inventor of the improved apparatus for this purpose, is likewise to have a vote of 300*l.* as a reward.

Main Drainage Works and the Railways.—The London, Tilbury, and Southend Railway Company, have agreed, through their engineer, to the proposition of the main drainage committee, to carry the main drainage works across the Bailsing branch of the railway, on condition that the said levels of the soffits of the construction be respectively 8 feet and 18·5 feet above the datum of the section: and that the works over the railway be carried over in such manner as may be approved by him, the Board paying to the Company, the sum of 5,000*l.* as compensation for all loss and inconvenience, and for executing the necessary alterations of the railway—the openings over the railway being, in each case, not less than 25 feet span on the square.

RAILWAYS, &c.

The "Ottoman" [Smyrna and Aidin] Turkish Railway (Chairman, Sir Macdonald Stephenson,) is still proceeding rapidly. The works upon the 40 miles out of Smyrna, constituting the first section of this line (the first commenced in the Turkish Empire) being in a very forward state, that section will, probably, be opened in September next. About 3,000 men, of different nations, are at present energetically employed on the works. The second, or tunnel-section, is also in rapid progress. The third section, to Aidin, offers less engineering difficulties than the rest; and its speedy completion is confidently promised.

The Total Receipts on Railways in the United Kingdom, for the year 1858, were £23,763,765 on 9,568 miles (including some canals), against £24,162,405 on 9,171 miles, 1857 (also including some canals), showing a decrease on the whole of about £400,000. The expenditure of capital on those railways amounted, in the aggregate, to £315,950,000; being at the rate of £33,000 per mile.

The Pacific [American] Railway.—The Special Committee of the House (advices to the 18th January ult.) had voted down all propositions respecting the immediate construction of this line.

A Fatal Railway Accident occurred (inquest held 29th January ult.) at the Camden Goods Station of the London and North-Western Line, to a number-taker, whilst on duty with his foreman, under the arch at Chalk Farm. An engine detached from some coal-waggons, having been shunted, ran back down the line. The buffer of the front truck struck deceased, who fell across the rail, and six of the wheels passed over his body, killing him on the spot. Verdict, "Accidental death."

Spanish Railways.—The receipts for the 1st week in 1859 show an increase of 26,407 francs, as compared with corresponding week of 1858.

Lombard Lines, for ditto, an increase of 109,102 francs.

Austrian, for ditto, an increase of 16,893 francs.

Mediterranean.—On the Line from Toulon to Nice, the preliminary works have been commenced at L'Esterel. Their object is to ascertain the probable expense of the three tunnels required at this spot.

Orleans.—The works have commenced on the Savenay to Redon Section of the Bretagne Line. A junction of the Breton Line with the Gare de Nantes, is seriously spoken of.

The [Proposed] "Metropolitan Railway" with a City Terminus has made another step in advance. At a recent meeting of the Ward of Farringdon-without, the Committee appointed to consider the site of the undertaking, reported in favor of the scheme.

The West London Railway Bill (for a railway across the River Thames to the West-end of London and Crystal Palace Line, and to the South Western at Battersea) has (22nd January ult.) passed the examiners on standing orders.

The Buffalo and Lake Huron Railway directors have been authorised to borrow the £50,000 required for the outlay of 1859 on 8 per cent. debentures.

At the Plymouth Station of the South Devon Railway the enlargement requisite for the traffic of the new lines proceeds rapidly. The rails are laid for the Cornish line to enter, and other additions are in progress.

Victorian Railways.—The sum of £8,000,000 is required, by the Victoria Government for the construction of railways between Melbourne and the principal centres of population upon the gold-fields. At one time (within the last few years) the cartage of stores to Sandhurst, a distance of about 120 miles from Melbourne, cost £160 a ton; and even at this rate, it appears the cartage did not pay. The amount was swallowed up in lost cattle, ruined horses, smashed wheels, broken poles, spoiled and pilfered loads, and the thousand and one other items of absolute loss and waste consequent on the want of means of due facility of transit.

An Express Engine off the Rail.—An alarming accident, happily unattended with loss of life, occurred, Sunday evening 23rd January ult., at the Manchester, Sheffield, and Lincolnshire Railway to the Great Northern express train, London for Sheffield and Manchester. Train consisted of two guards' vans and three first and second-class carriages; and, when at a curve between the Kiveton Park and Woodhouse junction stations, about 8 miles from Sheffield; it ran off the line—proceeded about 100 yards, tearing up and breaking the rails, and fearfully jolting the passengers. The engine eventually rolled over, lodging on the side near the top of the embankment. Coupling-chains broken in the fall, carriages fell over; and, remaining linked together, were thrown, one across the line of rails, and the other on the edge of the embankment. Head guard severely cut and bruised—three (of the fourteen) passengers much injured. Driver and stoker ditto. Train asserted to have been going at its usual speed of 40 miles an hour—others say at 50 or 60—to make up behind-time. Engine and tender much broken, carriages also; the ends and sides of several being smashed in—wheels and springs bent and strained, &c. Cause of accident variously assigned to breaking of a crank connected with axle of engine—to a defect in the rails—curve in the line, &c., &c.

The Goods Station at Keith, on the Great Northern of Scotland Railway, was, Sunday evening 30th January ult., burnt to the ground. Rumours of incendiarism, as the cause of the disaster, are afloat in the neighbourhood.

The London Bridge and Charing Cross (proposed) Railway, is intended to join the South-Eastern Railway near London Bridge, passing, in a westerly direction, near Union Street, and the Waterloo Station of the South-Western Railway, and over the Thames to Hungerford Market. The line, in its course, will cross the thoroughfares leading to and from Southwark, Blackfriars, and Waterloo Bridges, close to which, stations will be provided. Estimated cost of the line and stations, £800,000. Proposed line sanctioned by the Directors of the South-Eastern Railway Company. It is urged (we think with justice) that a railway station close to the great thoroughfare of the Strand, near Charing Cross, and communicating with all the railways south of the Thames, will be a great public convenience, and tend greatly to relieve the streets of traffic to and from the stations at London Bridge.

A Collision occurred on the Great Western Railway (half-past seven evening of 31st January ult.), between the Shiffnal and Oaken Gates Stations, 17 miles from Wolverhampton. An engine caught some waggons imperfectly shunted upon the siding about half-way between the two stations. Locomotive tender and first carriage thrown off the rails, and right across the line. Passengers much shaken (six or eight being severely bruised). The through-traffic interrupted for several hours.

Crossing Rails.—A fatal accident took place (1st February ult.) from this cause. The 8·15 a.m. express-train from Southport to Manchester was approaching the Dixonfield Station, at a reduced speed, in order to stop at the Aston Junction, when the guard's van in the rear got off the rails. The van swung against a bridge, and was considerably shattered. Brake-rod, underneath the carriage, next to the van, broken. Injury to carriage itself but trifling. One of the passengers in a second-class carriage, however, persisted in getting out of the carriage in search of his hat, which the wind had blown off. Whilst on the down-rails, a train from Manchester came by, at a rapid speed, and he was literally dashed to pieces.

The Northern of Spain, the statutes of which have recently been legalised by the Spanish Government (capital 100,000,000 fr.), is intended by means of the Trunk-line, and its projected (Government) Branches, to traverse the whole of the North of Spain, from Madrid to Irun, to the Point of Galicia, and all the ports of the first order, on the seaboard, Bilbao, Santander, Gijon, La Corogne, Vigo, thus supplying a route for the commerce of the interior of Spain with the Spanish Antilles and the North of Europe; and bringing Madrid into direct communication with the entire network of European railroads.

The Galveston to Houston and Henderson, at the head of the line from the Gulf of Mexico to New York, is in progress. 6,000 debentures (100 dollars or 530 francs each), have been issued for the construction of the third section. The two first sections (71 kilometres), forming the junction of Galveston Bay with Harrisburg and Houston, now in full activity, form, with the two railroads (the Central Texas and Brazos Colorado), a length of 272 kilometres, at present open for traffic.

The Guillaume Luxembourg Line, according to the convention just concluded between the Government of the Grand Duchy and the Railway Company, and sanctioned by the States of Luxembourg, is now circumscribed to three principal sections, stretching, respectively, from Luxembourg to Trèves (Prussia), Thionville (France), and Arlon (Belgium). The final completion of these lines is expected in 1859.

From Lintz to Budweis (in connection with the great "Empress-Elizabeth Line,") the directors propose the construction of a railroad.

New South Wales.—The Railway Loan Bill, providing for the construction of railways on the Southern, Northern, and Western lines of the colony, by funds to be raised by debentures, has passed the Colonial (Sydney) Legislative Houses.—Advices to 16th December ult.

The Melbourne and Hudson's Bay Railway Company, at their last half-yearly meeting, declared a dividend at the rate of 14 per cent. per annum out of profits (£25,917) for the six months.

Great Western.—Gross receipts on capital account to 31st December last, £23,601,485; ditto expenditure, £23,237,554, leaving balance of £363,931. Item in above accounts for expenditure on main lines and working stock, £10,903,785.

Great Southern and Western Railway of Ireland.—Receipts for the half-year ended 31st December last, £173,389, against corresponding half-year of 1857, £176,863, showing a decrease of £3,473.

Central Swiss.—The works are completed on the Aarbourg-Herzogenbuchsee-Berne and Herzogenbuchsee-Bienne lines. The metrical division of the railway, by means of milestones and numbering, has been completed on the other side of Hauenstein; and when the tunnel is finished, the same operation will be continued on the Olten-Bâle line. All the lines now open for traffic are affiliated by telegraph wires. Rolling stock consists of twelve locomotives (light-passenger), from the Esslingen Works—driving-wheels 5 ft. English; twelve other locomotives, to be delivered by same factory, in the course of this year (heavier build, driving-wheels 4 ft. in diameter). By contract with M. E. Kessler, the latter are to be constructed as "mountain locomotives" (similar to those of the Sœmmering), with six driving-wheels (coupled), and 3⅝ ft. diameter. To be applicable indifferently, either as tugs, to surmount the ridges on each side of the Hauenstein, or for dragging of goods' trains on other portions of the lines. They are to be capable of receiving, when empty, about 38 tons weight, and, on incline of 1 in 100, to draw a dead load of 4,800 cwt. (quintaux), exclusive of locomotive and its tender; and, on an incline of 2 in 100, a dead load of 2,700 tons. To be delivered in early part of 1859. Six other locomotives are also ordered by the Company, from their head works at Olten, on similar model; two of these are for use of their line; the four others ordered by the "Jura Industriel Company." The fifty-seven passenger carriages, and 210 goods' vans, ordered for the lines recently opened, have been delivered, the axles and wheels, for the most part, obtained from England. In anticipation of the opening of the Hauenstein tunnel, sixty new goods' vans, and ten first and second class carriages (eight-wheels), have been ordered of J. C. Reifert and Co., at Bockenheim, and of the Company's head factory at Olten.

The "Swiss Railway Waggon Factory," at Schaffhouse, has undertaken the construction of ten passenger carriages, with additional first-class seats, for the above Company.

Spain.—The Section of the Cordova and Seville Line, from Seville to Lora del Rio (about 35 kilometres), is to be opened in April or May next.

From Seville to Cadiz.—This line is to be inaugurated by the Queen in person, about the same time.

The Commission of the Cortes has unanimously pronounced for the appropriation of two milliards of reals for works of public utility (railways more especially).

La Corogne to Lugo.—The town of La Corogne has declared its intention of taking upon itself the cost of this section of the Galician line.

France.—The Orleans Railway Company, have decided on building a new and more extensive depôt at Charmont, between Laroche Chalais and Angoulême, to meet the increased goods and passenger traffic, from the communes of the cantons of La Valette and Blanzac, and the department of La Dordogne. Works to commence early in March.

Western of France.—The Argentan to Mezidon Section was opened on the 1st February ult., thus establishing a direct communication between Cherbourg and all the chief sea-ports.

India.—The Madras Line has now, on their South-Western Line and Branches, and the North-Western Line, 40 engineers.

The Branch Line from Coimbatour to the Neilgherry Hills is nearly completed. Greatest difficulty experienced in completing, has arisen from the want of sleepers; but a large supply of that article, both in iron and wood, is being sent out from England.

The Madras and Beypore Line, when completed, will save passengers, who may land at the last-named port, two or three days' voyage, superseding the necessity of their having to proceed round Cape Comorin; a great convenience, especially during the north-east monsoon, when it is so difficult to land at Madras, that passengers have frequently to go on to Calcutta.

Coal *v.* Coke, for Locomotives.—On the East Lancashire Line, for the last half-year, the actual saving, from the use of coal instead of coke, is announced as having been £1,680.

Ceylon.—On this railway, 8,000 additional hands have been employed, without causing any rise in the rate of wages paid by the Planters, as was at first dreaded. Average rate of wages (for efficient work), 7d. per day. For the permanent way, a large supply of sleepers, at from 4s. 6d. to 5s. each, have been received from New South Wales.

TELEGRAPH ENGINEERING, &c.

Ocean Telegraphy.—In Mr. Allen's New Submarine Cable, the metallic strength is placed in the centre of two folds of gutta percha; which are again covered by a mixed material as tough as leather, the total weight being 10 cwt. to the mile, and only 2 cwt. in sea water. Specimens of the new cable were recently produced, and the principle explained by the inventor (a telegraph engineer), at a meeting of the chief ship-owners and merchants at the Underwriters' Rooms, Liverpool.

The British Telegraph Company (Limited). — The Liquidator proposes to transfer the property of this line to the British and Irish Magnetic Company.

The Red Sea Telegraph Cable.—On the 28th January ult. the screw-steamers *Imperator* and *Impératrice*, having on board this new cable, sailed from Liverpool for Suez.

Uninsulated Wire immersed in Water has been lately, and, as it is said, successfully, tried as a conductor of electricity. Some recent experiments on this head have been made in the presence of the Lord Lieutenant of Ireland, in Phœnix Park, upon an uninsulated wire, upwards of 100 yards in length, immersed in water, and through which signals were freely sent. The experimenter not only sent messages through the core of the wire, but through the conductor and the outside metal covering of the rope simultaneously. The inventor, consequently, thinks that even in the case of the copper in the Atlantic cable being severed, he could still transmit signals along the outer covering of spiral wires [?].

Telegraph Wires.—Within the space of two months, in which the single wire of the electric telegraph has been laid between Stokesley and Pickton, on the North Yorkshire and Cleveland railway, a distance of 7 miles, no fewer than 8 partridges, 2 snipes, 1 woodcock, and 1 grouse have destroyed themselves by flying against the wire.

The Mediterranean Extension Cable.—On the 7th February ult. it was officially announced (in London) that electrical communication between Cagliari and Malta had been resumed,—"Cause of interruption not yet explained." The cable recommenced working at Malta at 7·15 p.m. on the 4th February ult., after an obstruction of 45 days.

The Operations of taking-up and Repairing the Malta and Cagliari Cable up to 28th January ult. are thus described by Mr. Webb, the civil-engineer of the Mediterranean Extension Telegraph Company, who reports (in substance) to the Naval Commander-in-chief Vice-Admiral Fanshawe, from on board the steamer *Elba*, 5th February, ult. as follows:—On 16th, 17th and 18th January, made electrical tests from Malta to discover distance of fault. Calculations pointed to a spot 15 nautical miles south-west (by compass) off Maritimo. 20th. Commenced dredging for cable on Adventure Bank, off Granitola, to pick up the fault. Evening of 20th, the cable was hooked, and hove up in 43 fathoms; Cape Granitola east-by-north-half-north, distant 16 miles. By cutting and testing found fault was towards Cagliari. More accurate tests showed fault to be only about 24 to 26 statute miles off. Picked up about 20 nautical miles of cable, when it parted at the bottom, on evening of the 21st, being under a wreck or rock—exceedingly probable that this is the original fault. Dredged for cable seawards of the spot where it parted, and obtained it on the 25th. Found cable perfect to Cagliari; fault probably, therefore, in short piece (about 1½ mile) between spot where cable was hooked and where it parted—probably at actual spot where it parted, that is, 15 miles south-west-quarter-west off Maritimo, in 160 fathoms water, and 175 nautical miles of cable from Malta. Obtained Cagliari end, and spliced on 3 miles of stout cable, and paid it out very slackly from forwards towards Malta. At 4.30 a.m. on the 26th, cable parted at the bottom. Very little lift on. Concludes that cable during fall of ship got tightly wedged in some crevice and, on the rise of the ship, of course parted. [Subsequently (see above) repairs completed and electrical communication re-established.]

The Electric Telegram announcing the safe delivery of the Princess Frederick of Prussia, reached Windsor Castle, from Berlin (28th January ult.), in six minutes after the the occurrence.

Alexander, Syria, and Constantinople.—The 27 political difficulties in connection with this telegraph line were (28th January ult.) officially announced to have been surmounted at Constantinople.

The Atlantic Telegraph Cable has presented no satisfactory sign of recovery since our last notice—viz., that the words "Henley" and "you understand," had (now about a month since) been received at the station at Newfoundland, and for a time revived the hopes that successful means had been found to restore the cable to working order. Unfortunately, a subsequent comparison of dates has shown that on the day these words reached Newfoundland, the station on this side the Atlantic, namely, at Valentia, was locked up and deserted, and that the supposed signals, therefore, were merely due to the constant and perplexing vagaries of earth currents.

The faulty portion of the immerged Cable is still conjectured to exist at about 220 statute miles from shore, or somewhere upon the now well-known submarine mountain-range which divides the deeps of the Atlantic from the comparatively shallow waters of the Irish coast: at the top of this ridge it is now conjectured that the cable remains suspended upon some projecting points of the steep; its insulation being gradually injured, if not actually destroyed, by its own weight. Instead of this ridge being, as it has been often stated to be, a mere "sloping bank," the result of two soundings taken upon it—one at the bottom and another at the top—shows a difference in elevation of 7,300 ft.

Sydney and Bathurst [N. S. Wales].—For the establishment of an electric telegraph between these points, £10,500 have been voted by the Colonial Legislature.—Advices to 16th December ult.

New Telegraph Lines between France and England. — The Paris *Moniteur* has recently published an Imperial decree approving of the contract entered into between the Minister of the Interior and the company represented by Sir J. R. Carmichael and Mr. J. W. Brett, for the construction in July, 1859, of a submarine cable-line between Boulogne and Folkestone. The Company also engages, during the continuance of the cession (for thirty years) on the demand of the French Government, to establish and work, within a delay of one year, a line from Havre to a part of the English coast hereafter to be fixed on]; and another between the English Channel islands and the coast of France, at some part between St. Malo and Cherbourg. Telegraphic communication by the lines of the Company, may be, at any time, suspended by the French Government without giving rise to any claim for indemnity. All the apparatus on the French coast to be exclusively worked by persons to be appointed by the French government and to be paid by the Company. The rate of charge by the new line from Boulogne, not, in any case to exceed that demanded by the first one from Calais.

Red Sea Telegraph.—Captain Pullen continues his surveys for the best line of submergence of a submarine cable. Mid-channel from Suez to Perim, on sounding, found to be "soft at bottom"—and from Suez to Jabal Teer, ditto; but "rock" from thence to Perim. Greatest depth, on this line, 1,050 fathoms—has also sounded the whole extent of the sea, in shore, and within the reefs on the eastern side: and the same from Suez to Suakin on the western side. Speaks favorably of a line now being surveyed from Suakin to Perim—as being, by far, the preferable route; the bottom, throughout, being more even, and the soundings considerably less.

Telegraph Prevention of Railway Accidents,—The Lancashire and Yorkshire Railway and some other Companies, have recently extended their respective telegraph-systems, throughout their lines, on a new plan described as speedy and simple, and which is said to answer perfectly. When a train, for instance, leaves Wigan for Bolton and Manchester, Wigan telegraphs to Hindley "train on"—and puts up the danger-signal or Semaphore, to prevent any train passing the station till Hindley telegraphs back "line clear"—which will be done as soon as the train has passed the station. Wigan then drops the signal, the Semaphore being raised at Hindley, which will also have telegraphed to Westhoughton; and the trains, both on the up and down-lines are thus handed from station to station along the line, with great facility: and as the stations are seldom above 3 or 4 miles apart, the new system enables trains to run at intervals of even five minutes, without, as it is alleged, the possibility of collision.

Anglo-Austrian (Alexandria) Line.—The Chancellor of the Exchequer (17th February ult.) announced in the House of Commons that the terms upon which a convention with the Austrian Government, for the establishment of a line of telegraph to Alexandria, will probably be concluded, have been settled, and, when concluded, it would be laid upon the table.

MARINE STEAM ENGINEERING, SHIPBUILDING, &c.

The "Mersey," 40, Screw, in Portsmouth Dockyard Steam-basin is progressing rapidly. Her screw (Maudslay) is a fine specimen of metal casting. Owing to its enormous size and weight (about 14 tons), it has been divided into three portions. The two blades are cast with flanges, and screw on to the centre boss with nuts and screws, rendering it so portable as to be easily taken apart, in the event of accident; also a great advantage in stowing spare blades. The *Mersey* is the most powerful frigate in the world at present; her broadside will throw solid shot or 10-in. shell; her "fighting quarters" are 18 ft. between the ports; can carry eight days' coaling at full speed (average 14 knots per hour). Tonnage, 4,000; cost, £200,000 Fitted with Clifford's Patent Boat-lowering gear on both sides.

The "Howe" Screw Steam-ship of the line, now building in Pembroke Dockyard, is so far advanced that she can be sent afloat this summer. This magnificent first-class man-of-war carries 130 broadside guns, and one pivot gun. She is larger than the *Duke of Wellington*, being designed to carry more than 4,000 tons.

The "Great Eastern," according to present announced arrangements, will make her first trial-trip (about the middle of July) from Weymouth to the middle of the Atlantic, to test her qualities, under all possible conditions of sail and steam.

The Trial-trip of the "Nepaul" Screw Steam-ship took place 29th January ult., from Southampton Docks, to test her speed at the measured mile. Average speed (of four trials), about 12¾ knots per hour; draught of water at the main, 15½ ft.; vacuum, 24; steam, 21; revolutions, 74; power, 200; capacity rated at 1,000 tons; has six life-boats hanging over her bulwarks. Will proceed to Marseilles on 1st April, and carry mails and passengers thence to Alexandria.

Capt. Kynaston's Life-boat Hooks were tried recently, in the presence of Admiral Kingcombe, &c., on board the *Doris* screw steam-ship, 32, when in the channel, in a heavy sea, while the ship was going 11 to 12 knots. The boat is reported to have been disconnected and hoisted in with perfect success.

The "Doris" New Screw Steam-ship, 32, whose trial-trip we noticed in our last, was, on that occasion, in charge of Captain Risk, of the Devonport Steam Reserve, and of Mr. Dinner, Inspector Afloat of Steam Machinery. She is fitted with trunk engines, by Messrs. Penn and Son, of 800 H.P. Working pressure, 20 lbs., with 52 revolutions.

The "Atlas," 91, Screw-steamer of the line, now building at Chatham Dockyard, will, in all probability, be launched during the present year, when she will be attached to the Channel Squadron.

The "Tasmanian" Royal Mail New Iron Screw Steam-ship, 2,440 tons, B.M., built at Port-Glasgow, in 1858, for the European and Australian Royal Mail Steam Packet Company, fitted with three trunk cylinder engines, by Inglis and Co., was (27th January ult.) put up for public sale at Lloyds' Captains' Room. A bid not being obtained, the vessel was withdrawn from public sale.

The "La Place," French Steam-corvette, narrowly escaped destruction from an accident that befell her on the 14th ult., in the China seas. She had approached the Chusan Islands, with a strong breeze and during a thick fog, and, instead of entering, as was thought, into the regular passage, got into a place where there was no outlet, and struck on a bank of mud. A boat was lowered, to take a hawser ashore; but she was swamped in an instant, and three men drowned. For two days and nights her situation continued to be critical, as the vessel sank deeper and deeper. Subsequently (1st December), some Chinese junks, sent from Shanghai to her relief, took on board the guns, ammunition, ballast, and heavy stores from the corvette; thus lightened, she rode easier, and by means of an anchor, carried out at high water, she was hove afloat in about 8 fathoms. Her hull and engines had not received any material injury.

Steam-power and the Navies of Europe.—In the recent Royal Speech on the opening of Parliament, Her Majesty is made thus to allude to one of the great changes consequent on the progress of science and machinery. "The universal introduction of steam-power into naval warfare will render necessary a temporary increase of expenditure in providing for the reconstruction of the British navy; but I am persuaded that you," [the Commons], "will cheerfully vote whatever sums you may find to be requisite for an object of such vital importance as the maintenance of the maritime power of the country."

The "Windsor Castle," 112, was (3rd February ult.) lashed to the jetty at Devonport, in order to try her machinery.

Iron Ships and Compass Errors.—A new instrument for ascertaining and correcting the local errors to which compasses are peculiarly liable on board iron steam-ships has been lately invented by Mr. R. Eardly Pinkey, a chief officer in the Peninsular and Oriental Company's service. It consists of a chronometer-box, hung on jimballs, having over the top a "dumb-card," (similar to Friend's pelorus), and an "equatorial" (or sun) dial, which, by means of a graduated arc at the side, can be adjusted to the latitude of the place. The observer, with a watch set to the apparent time, or time of the ship, causes the shadow of the dial to fall on the part of the instrument representing the time. One portion of the cross will then be in the direction of the true meridian of the place; consequently all true bearings can be ascertained at once—all magnetic bearings, by applying the known variation for the place of observation. The instrument may be used in any part of the ship; the only adjustment required, being to put the lubber line towards the ship's head; then by placing the dumb-card to correspond with the meridian, or the magnetic meridian, as may be desired, *the difference between its indication and that of the compasses on board* will be the errors, for which allowances must be made.

French War Steamers in Commission.—The Minister of Marine, in a recent dispatch (22nd January ult.) has ordered the following steam-ships, at present in the port of Brest, to be put "in commission," by which, he is at some pains to explain, he means "to be made ready for sea at a moment's notice;" all her works of construction, repairs armament, &c., being completed. The steam-frigates *Caffarelli, Panama, Descartes, Orenoque, Danal, Amazone, d'Assas, Caton, Chimère,* and *Montezuma*; the auxiliary, screw-ships *Turenne, Duguesclin, Breslau, l'Imperial, Tilsit, Ulm,* and *Wagram*; the steam corvette *Gassendi*; the transports *Garonne, Monges,* and *Forbin*; and the floating-battery *Congrève*. As to the auxiliary screw-ships *Louis XIV., Tagus, Dugay Trouin, Jean Bart,* and *Duquesne*; and the steam-frigate *Ardente*, he says he does not speak, as he considers those vessels as completed with respect to the repairs of their boilers and engines.

Steamer Collision.—The screw-steamer *Sultana*, when coming out of the Humber at 5·30 a.m., on the 30th January ult., came in contact with a smack which was entering the river, and which instantly went down in very deep water. She was believed to be manned by two men and a boy. The steamer lost her bowsprit, and remained near the spot for some time, but could find no trace of the crew.

Her Majesty's Screw Steam Frigate "Curacoa," 31 (from Spithead to Plymouth) (3rd February ult.), to embark Lord Lyons and suite, came in contact, on the 4th, 3 p.m. (20 miles off Durlestone Head), with the schooner *Fleta*, of Shoreham, to Cardiff, in ballast; the latter received considerable damage, but arrived (same day) at Portsmouth.

The "Avon" Brazilian Mail Steamer was forced, on her recent voyage, to put back (5th February ult.), to Lisbon with her main-shaft broken "clean off." The passengers and mails were to be sent home by the Peninsular and Oriental *Alhambra*. The *Avon* has since (14th February ult.), arrived at Southampton.

The Niger Exploring Screw Steamer "Sunbeam" (one of the small (steel) steamers engaged in the Niger expedition, arrived (7th February ult.), at Liverpool, with a cargo of palm-oil.

Her Majesty's Iron Screw Steam Store-Ship "Supply," recently under repairs, on return from shipment of antiquities from Halicarnassus, in Boudrun Bay, was (4th February ult.), undocked at Woolwich, and reshipped her boilers.

The Paddle-wheel Steam-vessel "Banshee," lately on a surveying commission in the north, was (13th February ult.), docked at Woolwich, to be overhauled and repaired

The "Fairy" Royal Screw Steam Yacht, having completed repairs to her hull, in No. 1 dock, at Portsmouth, was (3rd February ult.), towed round to the steam-basin to receive her boilers and machinery.

Her Majesty's Steam-Yacht "Victoria and Albert," was removed from her harbour-moorings at Portsmouth (same day) to the steam basin, to undergo her annual overhaul and renovation.

The Indus Steam-Flotilla.—The trial-trip of a model steamer, constructed for this new enterprise, from the design of Mr. Scott Russell, was (7th February ult.), made down the river in presence of several scientific parties and of some of the directors of the Scinde and Punjab railways. The requirements for Indian river-navigation, especially during the dry season, are somewhat, apparently, incongruous—viz., great power, high speed, ample stowage for cargo—with less than 2 ft. draught of water. The boat resembles the American river steamers, flat bottomed, square-shaped, and with a deck-house, which almost covers the entire vessel. Length over all 200 ft.; breadth, 38 ft.; draught of water, 1 ft. 10 in.; average speed (as a passenger-boat) 13 miles an hour:—and with boats containing 500 tons cargo in tow, average speed (on the Indus) 8 miles an hour. Two longitudinal wrought-iron girders run the whole length of the vessel, rising nearly 10 ft. above the deck, so as to form the walls of the deck-cabins. The girders constitute the main strength of the hull. Engines of, nominally, 120 H.P., constructed to work up to 400: but in reality, in the indicator, give more than 600. On Mr. Russell's 3-cylinder principle. Her draught on trial-trip 1 foot 10 in.: forward, scarcely 20 in. Experimental trip considered satisfactory.

The "Winans" or Cigar-shaped [American] Steam-Ship, built by the Messrs Winans, of Ferry Bar, South Baltimore, has, according to the Baltimore papers, made a successful trial-trip. With a pressure of about 56 lbs. of steam to the sq. in. (about half the capacity of the engine), a speed of 12 miles an hour was obtained. The points of the bow and stern barely touched the water; and the even progress of the vessel caused no commotion of the waves, but left a smooth wake, like a groove. Ventilation below decks perfectly preserved during running of the machinery; thermometer never rising above 65° Fahrenheit. Another paper gives 14 miles an hour, with a moderate head of steam, as the speed attained.

A Disastrous Steamer Collision at Sea occurred 8th February ult., about 1 a.m., 13 miles from Fleetwood, between the steamer *PrincePatrick*, of that port, and the iron schooner *Elfin*, from Liverpool for Ardrossan, loaded with 226 tons of pig-iron, and 9 souls aboard. At moment of collision (6 or 8 miles S.W. of Walney Island), speed of steamer, 10 miles per hour; that of schooner, 8 miles per hour. Schooner cut almost in two; filled immediately, and went down in about two minutes, with all on board. The master, his wife and child, and two men, went down with her and perished; remainder of crew (four men) escaped by grasping hold of steamer's bows. The *Prince Patrick* (one of the largest steamers on the line running daily between Fleetwood and Belfast) considerably damaged; her plates of iron on the water-line, on the port bow, for several feet from the outer-water, being ripped open, the water rushing into her fore-compartment; but further ingress prevented by bulkheads. Put back to Fleetwood to repair damage. Conjoint loss (of schooner, and damage to steamer), estimated at between £3,000 and £4,000. Cause of collision not yet ascertained. On the 9th, the *Elfin* was lying with part of her spars above water, in above 12 or 13 fathoms, Walney Light bearing E.N.E., the Wyre Lights, S.E. ½ S.; no tidings of the missing bodies.

The Loss of the "Czar" Screw Store-ship (See "Notes and Novelties" for (February ult.) was the subject of inquiry and explanation in the House of Commons, when the First Lord of the Admiralty stated that the conduct of commander of H.M. steam-sloop *Virago* (who saw the *Czar*, go ashore off the Lizard, in the middle of the day of January 22nd, but continued her course without making any attempt to succour the crew, fourteen of whom perished), had (after due official inquiry) met with the disapproval of the Board of Admiralty, who had communicated to the commander in question their opinion "that he (the commander) would have acted with a sounder judgment if he had at least made the attempt to rescue the crew of the *Czar*.

The "Reconstruction" of the Steam Navy.—In the Naval Estimates for 1859-60 just issued, is included an "extraordinary" charge of £985,707, as wanted "to meet the extraordinary charge to be incurred during the year in consequence of the additional work to be undertaken for the building and conversion of ships of war for the steam-navy, and providing machinery for the same." The details of this charge, as required for "the reconstruction of the navy," are given as follows:—Purchase of timber, masts, deals, &c., £82,800; of other stores; £17,200; purchase and repairs of Steam Machinery, £335,000; for ships, to be built by contract, £252,000. Remainder for wages, viz., over-hours, beyond day-pay, provision by ordinary estimate, £131,735; for wages of hired artificers, &c., to be employed, £165,972; for additional pay of officers superintending shipwrights' labour, £1,000; total for wages being £298,707.

Collision.—The Cunard screw-steamer *Jura*, for New York, at anchor off Egremont (14th February ult., 5 a.m. flood tide, fog thick), was run into by a steamer (said to be the *Windsor*, from Dublin), which latter was attempting to turn in the river. *Jura* struck on the bow; stern much damaged, and will have to go into dock for repairs. Crew not injured.

The New Australian Steamer Mail-contract by the Peninsular and Oriental Company, commenced 16th February ult., by the dispatch of a mail-steamer from Sydney for Suez, which was expected to reach the latter port on the 28th March inst. The new monthly service from Southampton will commence on the 12th March inst.

The Super-heating Steam Apparatus—(Plan of Mr. Partridge, Assistant Engineer of the Dockyard Factory), for economising the consumption of fuel on ship-board, was, by special order of the Admiralty applicable to foreign visitors, inspected in Woolwich Dockyard, by M. Vianson, Inspector-General of Steam-machinery, in the service of H.M. the King of Sardinia, with the view of introducing the same into the naval service of that country.

MILITARY ENGINEERING, &c.

Capt. Norton's New Rifle Bullet is undergoing further trials at Chatham. The small film of paper with which the bullets are coated is found to lessen the friction which the ordinary rifle bullets undergo before they leave the rifle, thereby materially diminishing their propelling force, and affecting the accuracy of aim. He discards the ordinary "plug" at the base,—one description of bullet having a nail or screw inserted at the base, and in the other kind, the hollow for the powder being very large. The trial-range was 250 yards. The ordinary expanding-shot for the Enfield rifle requires the finest lead for casting; but in the paper-coated ball of Capt. Norton any lead will answer. The mould in which the newly invented bullets were cast, was made by Mr. Lancaster to correspond with the elliptical bore of his rifle.

A regular School of Gunnery is being formed at Shoeburyness, where a systematic teaching of gunnery is to be matured. Evening Lectures have also lately been delivered in the Royal Artillery Regimental School, at Woolwich, to the non-commissioned officers and gunners of the corps. On a recent occasion the lecturer (Col. Wilford, R.A.) said that every company of Artillery should be a school of gunnery, under its own officers.

The Gunboat Sheds and Slipway at Haslar were officially visited (5th Feb. ult.), to test the operation of removing one of the gunboats from under the sheds, and, by means of a cradle, tramway, and incline, launching it into the water. The whole operation occupied 27 minutes. The previous experiment (on the 2nd February) was effected in 38 minutes 40 seconds.

Coast Fortifications.—A London building firm has taken the contract for building forts at Higher Tregantle and Antony, which are to be proceeded with immediately.

Rifled Ordnance (according to French military authorities on the point) can carry 8,000 metres.

The Defence of Marseilles appears to be one of the questions now seriously occupying the attention of the French Government. The "Messager du Midi" announces that the mixed Commission of Public Works have, from motives of economy, rejected the project of a breakwater, the cost of which was estimated at not less than 152 millions (francs). The creation of new batteries has therefore again come under consideration, viz., one on the Point of Eudourne, the fire of which would cross with that coming from Ile des Perdus; the latter again with the fire of the Fort of If; and the fire of If with that of the Ile de Pomegue. On the north-east, a battery to be placed on the Cape Couronne, would throw its fire across that of Ratoneau. As regards the entrance of the Port, in case vessels of war should succeed in getting through one of the passes, they would find themselves between the fires, coming first from the advanced points of the coast; next, those of the batteries of La Joliette, the Napoleon Dock, and the contemplated Port d'Attaque.

Iron Guns.—Government, it is alleged, have completed a contract with three large iron companies for a supply of 68-pounders as fast as they can be cast. An important contract for gunpowder has also been taken.

The Chatham "Royal Marine Barracks" are being, by order of the Admiralty, considerably enlarged, so as to enable them to accommodate several hundred additional officers and men. For this purpose adjoining property has been taken possession of, and the houses thereon taken down, to afford the required space.

A New "Incendiary Shell," invented and called by Captain Norton, "the liquid-fire rifle shell" has been (11th February ult.), successfully tested at Chatham, before several officers of the Royal Engineers. The results of the experiments are stated to prove that the shell in question is "one of the most extraordinary projectiles ever introduced into the art of warfare." In reference to the above, Mr. John Macintosh has directed public notice to his recent patent, No. 1,774, for a shell filled with coal-tar naphtha, mixed with phosphorus and bisulphuret of carbon, having a bursting-charge sufficient to open the shell, which, when exploded, scatters its contents in all directions; the shower of inflammable material, falling among cavalry and troops, causing their immediate disorganisation and destruction. Similar results for shipping, harbours, dockyards, or towns. Mr. Macintosh adds, that in 1853, he offered his invention to the Government; but that Lord Panmure, then Minister of War, *interdicted the sealing of his patent*, on the grounds of its efficacy and great value; which interdict has since been removed by his lordship—the patent has been sealed, and consequently made public. [Are we, from this, to understand that Mr. Macintosh claims identity of his shell with that of Captain Norton?—Ed.]

French Floating Batteries.—The steam line-of-battle-ship, *Jemmappes*, now at Toulon, is to be transformed into a floating-battery on the new principle, of which it is to form the model. These new batteries are to be "enormous naval constructions, covered with a sheathing of wrought-iron; but instead of being, like the former ones, "wall-sided"—a form which allows the new cylindro-conical balls thrown by the Paixhan's and Armstrong guns to penetrate the iron and to explode in the side of the vessel, the new floating forts will have their sides built in a curve, and fluted at intervals, so that the shot will not, one time in twenty, strike on a flat surface; and will, consequently, fly off without doing any injury." As a specimen of the wonders anticipated to result from these new war-engines, destined (*inter alia*) "to render powerless the fortifications which command *certain important maritime straits*, "Galignani" adds "two of these vessels, placed on the coast of Ceuta, would completely paralyse the guns of Gibraltar, and would be masters of the Pillars of Hercules." ! ! !

French (Improved) Gunpowder.—The Minister of Commerce has addressed a circular to the chambers of commerce throughout France, informing them that the Minister of War has succeeded in manufacturing gunpowder suited for exportation, of *a better quality than that now used*, and the price of which will enable French ship-owners to compete with foreigners; that the experiments in the manufacture of the new gunpowder have been made at the powder-mills of St. Chamax, St. Medard, and Du Bouchet; it may be sold at 130 fr. the 100 kilogrammes. That further experiments made by the director of the Government gunpowder and saltpetre stores show that the same gunpowder may be manufactured for 120 fr. the 100 kilogrammes, and even cheaper. This new gunpowder is composed of 72 parts of saltpetre, 13 sulphur, and 15 charcoal.

Austrian Guns.—The *Weiner Zeitung* (February ult.) states that 1,000 guns of the largest calibre are to be cast at Mariazell, in Styria, in the course of the present year.

An Explosive Percussion-bolt Signal, another of the recent inventions of Captain Norton, has been tried at the head-quarters of the Royal Engineers' establishment, Brompton. It is to be used as a military alarum-signal. On being allowed to fall from the hand, either on the earth or even on grass, the signal exploded with a sufficiently loud report to be heard at a considerable distance. The inventor proposes to apply the same principle to signals to be used on railways, so as to enable passengers and guards to communicate with the drivers of engines.

HYDRAULIC ENGINEERING.

The General Hydraulic-Power Company's Bill (1st February ult.), came before the Examiners for Standing Orders. Report, "Not complied with."

The Mont Cenis Hydraulic Boring Machines—("*compresseurs hydrauliques*") are being manufactured at Seraign, in Belgium. This immense apparatus to be used in the stupendous enterprise, recently undertaken by the Sardinian Government, namely, the driving a tunnel through Mount Cenis, thus uniting the valleys of Piedmont with Upper Italy, is the invention of three Sardinian engineers, and consists, mainly, of an hydraulic compressor which, after having compressed the air, by means of a fall of water, sends it into the interior of the works, where this compressed air acts as a motive power, to force into the body of the rock the blasting-drills of the miners, and thus form mining-cavities (*des trous de mine*.) The compressed air, moreover, serves as a motive force to clear away the *débris* resulting from the explosion: and it also furnishes the means of ventilating the tunnel. The apparatus is being constructed under the direction of M. Sommeiller, a Sardinian engineer, one of its inventors. Experiments are shortly to be tried at Seraing, in order to test the late improvements made in these machines, by means of which the great tunnel (13 kilometres) in length, through Mont Cenis and between Modane and Bardonnèche, is expected to be bored, in less than six years: a gigantic undertaking, which, under the old system, would, necessarily, have taken 30 years to complete.

The New Derrick and the "Great Eastern."—On the 14th February ult., the operation of hauling the massive wrought-iron intermediate shaft for the paddle-engine of the great steam-ship, was performed by the new patent derrick. This shaft is the largest piece of forged iron-work ever manufactured, its weight being nearly 40 tons. Before complete absence of flaws (in forging such a ponderous mass) could be achieved, four had to be manufactured, three of which turned out to be faulty on trial; but the fourth was found to be perfectly sound. The shaft was taken on board the derrick from Mr. Scott Russell's yard, and brought alongside the ship; chains made fast to it; and operation of hoisting performed with the greatest ease and facility in about seventeen minutes. Shaft deposited on a wooden bed close to the bulwarks, on the port side of the ship, the "trim" of which was not thereby in the least altered.

WATER SUPPLY—(METROPOLITAN AND PROVINCIAL).

Sanitary Influence of a Pure Supply.—In the recent quarterly return published by authority of the Registrar-General, the excessive mortality of the year 1858 is traced "partly to defective supplies of pure water,"—that at Bedlington [sub-district of Morpeth, Northumberland,] "the death-rate is steadily increasing year by year,"—"want of water" being adduced as one of the chief predisposing causes of such increase. In the instance of the sub-district of St. Peter's, Brighton—[where the deaths (386) exceeded the births (375)]—the registrar observes, "In many of the dwellings, *a very insufficient supply of water* has been available to them (chiefly the poor inhabitants), owing to the dryness of the weather in the first portion of the quarter; the water of the wells in use having been very low;" whilst, on the other hand, "Morpeth has main sewers, *as well as a water supply:* fever has nearly disappeared, and cholera has been averted."

The Shepton Mallet Waterworks Bill has (28th January ult.) passed the Examiners for Standing Orders.

The Poole and Bournemouth Waterworks Bill, ditto.

The Artesian Well, at Ostend, long—(at one time, indeed, it was deemed almost hopelessly)—bored for on the sea-shore, and only 4 yards above high-water mark, has, at length, given an abundance of water; at a depth of 180 ft., the stream rose, and the inhabitants, hitherto grievously suffering from the want of good drinkable water, will now have an abundant supply.

The Sinclair Fountain, the first of a projected series, originating with Miss Catherine Sinclair for the establishment (in Edinburgh) of drinking-fountains in public places in that city, is to be placed at the extreme west-end of Princes' Street, where the Lothian Road and Rutland Street conjoin. Structure, freestone. To have the base and general form of an equilateral triange—its three sides or façades being of similar aspect and decoration—in the later or Italian period of Scotch architecture. Height from level of the street, 15 ft.

The Eastbourne Waterworks Bill passed (5th February ult.) Committee of Standing Orders.

The Norwich (City) Waterworks Bill has passed the Standing Orders Committee.

The Glasgow (Corporation) Waterworks Bill, ditto.

The Wioral Waterworks Bill, ditto.

West Indies.—In the Jamaica Legislative Council, the bill for guaranteeing the Bridgetown Waterworks Company a loan of £25,000 (which passed the House of Assembly on the 21st December last), was read a first time, and ordered to be circulated.—Advices to 26th January ult.

Victoria, British Caledonia.—The site chosen for the capital of this now rapidly rising colony possesses the advantage of having an inexhaustible source of water-supply from a lake which is only eight miles distant, standing at an elevation which will command the tops of the highest edifices which may be erected in the new city.

BOILER EXPLOSIONS.

On the Brunton and Shields Railway a fearful boiler explosion occurred (26th January ult., about a mile and a half from Percy Main) in the standing engine, working the incline on this railway, by which the coals are sent down to the Staiths in the Tyne. By the explosion, the boiler was lifted up and torn into four pieces, the principal portion being thrown across four railways, and over two deep cuttings. Another portion struck a neighbouring cottage, nearly demolishing it. Engine-house completely demolished, and the workmen in charge buried under the roof and ruins of the building. A portion of the boiler flying across the waggon-way, cut the rope of a set of waggons then running down the incline, and set them running amain with great velocity down to Percy Main, causing considerable mischief. The unfortunate man in charge was, by great exertion, dug out from the ruins, and his dead body removed, dreadfully mutilated. Cause of explosion not ascertained; but supposed to have been a scarcity of water.

At Halifax (24th January ult.), a boiler, erected in the kitchen of an hotel, to supply the baths, exploded, severely scalding three women. Boiler torn into ribbons, which were blown in all directions. The oven was also blown from its bed, and carried to the other end of the room, cracking the stonework of the fireplace, and causing other damage.

GAS ENGINEERING—(HOME AND FOREIGN).

In Dublin, the Gas Companies have reduced their price to 4s. 9d. per 1,000 cubic feet. An opposition Company (the "Independent Gas Consumers'") has been started, professing to supply better gas at 3s. 6d. per 1,000 cubic feet, free from meter-rent.

An Explosion of Gas occurred, about 5 p.m., 25th January ult., at the United Service Club, Pall-mall. Some workmen were engaged in the basement (exterior) of the building, when, owing to a leakage from the main, a violent explosion took place, causing considerable (local) damage, and great alarm in the immediate neighbourhood, but, happily, no personal injuries.

The Bury St. Edmund's Gas-Bill has (28th January, ult.) passed the Examiners' for Standing Orders.

The Tottenham and Edmonton Gas Works Bill has passed the Examiners' for Standing Orders.

Gas Works have been erected for the exclusive use of the new Wellington College. The whole of these works and fittings were executed by Mr. George Wallcott, C.E., in the brief period of three months. Fittings supplied and fixed also by him.

A New Manufactory of Dry Gas-Meters, under the auspices of the Lord Mayor and others interested in the supply of gas, has been opened in the Kingsland-road. The several compartments for case-constructing, leather-cutting, index-making, and brass-finishing and completion, afford employment for upwards of 400 workmen.

An Improved Gas Burner has been patented. The principle consists in combining two or more burners projecting flat or sheet-like flames, in a nearly horizontal plane, in the interior of a shade or dome, the burners being situated eccentrically to the axis of the shade or dome; and being so situated with respect to the shade or dome, the flames converge towards its middle or axis.

BRIDGES, VIADUCTS, &c.

London Bridge—New Steamboat Pier.—The opinion of the Court of Common Council has been taken in relation to works in progress at London Bridge, under the direction of the Thames Conservancy Companies, who are about constructing a permanent fixed landing-pier in front of the south-west and south-east landing-stairs of the bridge. The pier to extend about 34 ft. into the river. A similar pier is to be erected in front of the east and west landing-stairs of the north end of the bridge. To both these intended undertakings (actual operations to forward which, such as dredging, &c., have been commenced) Sir John Rennie is strongly opposed, for various reasons connected with the (alleged) injury likely to arise therefrom to the navigation of the river, the stability of the bridge, &c. &c., and, after an apparently fruitless remonstrance and correspondence, addressed by him to the Controller of the Bridge House Estates, the matter came (24th July ult.) before a Special Court of Common Council, on a motion that the letters of Sir J. Rennie and the petitions [" from wharfingers and occupiers of property on the north and south sides of the Thames, against the piers and works, &c., now in progress under the arch of London Bridge"] be referred to the Bridge House Committee. After a long discussion, the Court divided: 38 for the affirmative, and 38 for the negative. The Lord Mayor then gave his casting vote against the motion, which was consequently lost, amid much cheering.

The Londonderry Bridge Bill has (28th January ult.) passed the Examiners for Standing Orders.

The Caerhowel Bridge, over the river Severn, Newtown, Montgomeryshire, appears to be in sad want of improvement. A young man passing over it, with a team of three horses (1st January ult.), was, together with his team, &c., swept away and drowned, the river having swollen in consequence of the late rains. The bodies of the horses were found about a mile and a half from the scene of the accident; but the remains of the young man were not recovered, the muddy state of the stream rendering effectual search impossible.

A very simple and ingenious Balance Rolling Bridge, invented by Mr. M. Kenney, engineer, Dublin, is in course of manufacture by Messrs. Turner and Gibson, of the Hammersmith Iron Works, Dublin. Amongst the merits possessed by this invention, are the simplicity of its construction and working. The Bridge is constructed with two longitudinal beams of iron or wood, with flooring joists and flooring, balanced and travelling on two rollers, and raised, opened and shut by two others, requiring only one and a continuous motion, from the time of starting until either opened or shut. Its moderate cost and expenditure for repairs, in comparison with swivel or ordinary Rolling Bridges is evident, and as it will require no intricate or expensive stone-work, its erection will be inexpensive. Its particular applicability for a double road and pathway, portability for exportation, and capability of being made and erected by any ordinary mechanic, are also advantages which will be appreciated.

At Kehl, over the Rhine, the works of the new bridge are in constant progress. The 'provisional' bridge, on the opposite bank, is completed up to the first pier. The scaffoldings surrounding it, and which are to serve for the construction of the piers of the 'definitive' bridge, are of gigantic dimensions. Here, on a cradle, are deposited the large iron caissons which are to be sunk into the bed of the river as foundations for the piers. In a few days the operation of sinking them will commence, and workmen will then be sent down, under water, to begin the masonry. The necessary apparatus to enable the men to work, without inconvenience, under water, has been provided.

A Steam-Floating Bridge, to connect East to West Cowes on the plans of Mr. Hodgkinson, having been approved by the Directors (Qy. of the Cowes and Newport Railway Bill), his tender to construct it has been accepted. The Directors wished to have it ready by the 1st of May, but it will not, probably, be at work before the 1st of July.

The "Pont de la Vire" railway bridge, on the Western of France line (branch from Lisbon to Saint Lo, on the Caen and Cherbourg line), recently had its works interrupted by the filtering of the water of the river through the dams, and consequent sapping of one of the foundations of one of the piers now in course of construction.

The New "Pont Hebert" (on same line) is completed.

A Bridge over the River Murray, at Albury, New South Wales is to be erected. In the Colonial Government estimates recently [advices from Sydney to 10th December ult.] presented to the Houses of Legislature, and agreed to, was an item of £10,000 for the construction of this bridge.

A New Suspension Bridge, recently erected over the Garonne, at Marmande, has failed under the usual tests. The masonry-work split in several places. The entire bridge must in consequence be taken down and rebuilt.

A Suspension Bridge at Grand Falls, C. W., which had just been erected, at a cost of 20,000 dollars, fell recently—one of the chains having snapped in consequence of the cold. Three teams passing upon it were lost, and two men dangerously injured.

On the Hudson (near Hudson City) a bridge has given way. The land between the former place and Albany being [advices to 24th January ult.] overflowed in many places, and a "freshet" on the river threatened.

The Burton-upon-Trent Bridge Bill (1st February ult.) came before the Examiners for Standing Orders.

HARBOURS, DOCKS, CANALS, &c.

Chatham.—The large Stone Dock, which has been constructed at this dockyard at a considerable outlay, is now ready for the reception of vessels. The channel at the entrance to the basin has been considerably deepened by the piles which obstructed the entrance having been drawn, so that the largest line-of-battle ships in the Navy can now be floated into the basin to be fitted or repaired.

Bristol Dock [Extension].—Resolutions for extending the dock accommodation of this port, "so as to meet the requirements of the largest class of ships and ocean steamers, were (26th January ult.) passed at the recent annual meeting of the Bristol Chamber of Commerce. Amount of foreign and colonial tonnage entered inwards, with cargoes, during the year 1858, was 846 vessels, of 199,119 tons, against 690 vessels, of 185,762 tons, in 1857, and 670 vessels, of 172,050 tons, in 1856, showing a progressive increase.

The Harbour of Smyrna, the first city in the Ottoman empire, is considered one of finest and most frequented in the world. In 1847 (according to the return of the Austrian consul there) the imports amounted to £2,447,493, and the exports to £2,397,342. In the preceding year (1856) its tonnage inwards and outwards, amounted to 869,380 tons.

Mersey Steam Tug Rocket Signals.—The Mersey Dock Board having recently, in a communication from the police authorities, had their attention directed to the danger of using rockets at night as signals for steam-tugs (one of these missiles, for instance, sent up for this purpose having, a few nights since, fallen upon the deck of a Dutch barque, nearly setting fire to the vessel), have referred the matter to one of the sub-committees for investigation.

Birkenhead Docks [Extension].—The Board of Birkenhead Commissioners (Mersey Dock and Harbour), have instructed their Engineer to prepare plans of the works actually required. Further, they have sanctioned the contract of Mr. McCormick for the construction of a coffer-dam for £21,000, at the entrance of the proposed low-water basin at Woodside.

New Docks and Harbour at Falmouth are, in all likelihood, about to be constructed. A plan of the same having met the support of a meeting held (18th January ult.) in the Town-hall, Truro, Viscount Falmouth presiding: he stated that the mails were removed from Falmouth in consequence of the want of dock accommodation there for steam-traffic and a railway. There was now a railway to within 11 miles of the port; and the new docks in question would supply the remaining deficiency. The engineer recommended by the Admiralty has selected a site for the proposed docks, in vicinity to deep water—the rise of tide being 18 ft. 6 in. at spring, and 14 ft. at neaps. There is to be a tidal harbour of 12 acres, with a depth of 18 ft. at low-water spring tides, and a channel of the same depth leading out to deep water; two slips, a dry-dock, warehouses, &c.; a half-tide basin or dock of 8 acres, connected with the tidal harbour; entrance into the latter to be a straight one, 80 ft. wide, and the same to the graving-dock, so that with the exception of the *Great Eastern* there will be entrance-room for the largest class of ships now afloat. Estimated cost of entire works, including landing, warehouses, &c., £200,000, towards which Falmouth has already subscribed £37,000.

Liverpool Docks [Proposed Extension].—The New Dock Board have recently resolved to apply to Parliament for power to borrow £300,000, for the purpose of improving and extending these docks. Proposition carried by 15 to 6. The receipts of the Board for 1858, have exceeded those of 1857 by £500, through the returns in 1857 were greater than had previously been experienced.

The Southampton Docks' capital was £800,000. One dock within the tidal harbour comprises 10 acres, but the entrance is only 46 ft. wide; and the large Royal Mail steamers cannot get in, as they are wider across their paddle-wheels than the entrance.

Government Dockyards. — In the Navy Estimates for 1859-60, £573,498 is required for new works, improvements, and repairs in the dockyards.

Dock and Goods' Traffic on the Thames.—An influential meeting of dock-proprietors, coal merchants, and wharfingers, has been held recently (1st February ult.) at the Bridge House Hotel, Southwark, to support an application now being made to Parliament for the removal of "the present arbitrary restrictions upon the navigation of the river, as respects the goods' traffic;" in other words, to obtain the repeal of the 7th and 8th George IV., c. 73, commonly called the "Waterman's Company's Act," under which an intolerable monopoly has grown up; the sole right of using the river as a highway for commerce being vested in the Freeman's Company; and the only way in which a person can become free of the Company, is to serve an apprenticeship of seven years as a working lighterman which must begin between the ages of fourteen and eighteen. A committee was appointed to watch the progress of a Bill for repealing the Act now before Parliament.

Galway Port and Harbour.—In the House of Commons (4th February ult.), Sir J. Pakington, as First Lord of the Admiralty, announced that he would shortly lay on the table the Report of the Irish Government Commissioners, appointed last October to inspect the port and harbour, and to report on the condition and wants of the same, adding that "the report was very favourable to the facilities of the port."

The Crinan Canal, or, at least, that portion of it (about two miles in length, in Glen Crinan, together with tow-path highroad, &c.) has been totally destroyed, through the bursting, on the evening of the 2nd February ult., of one of the reservoirs,* which, in consequence of the late unprecedented wet season, becoming overcharged, suddenly burst, and precipitated its waters into the one beneath, which, also giving way, the contents of both bounded into a third; and an avalanche of water, rocks, and earth rolled down the mountain-side, obliterating the canal under a mountain of *débris.* The lock-gates were broken up, and tunnelling vast chasms through the banks, the waters found vent over the open country, one stream by the town of Lochgilphead into Loch Fyne; the other over the Crinan mosses into the Western Sea. Loss of property at present incalculable; but, happily, no fatal results: remaining portions of the canal (about 4 miles at either end) intact, or not irreparably injured. Pressure on the banks enormous, as the waters swelled over their edges for their whole length; and the village of Ardrispaig was probably only saved by the immediate opening of the sluices, and giving vent to the waters, which must, had the bank given way, have swept the village into the sea.

[* *Note.*—The highest elevation of the canal is at its centre, about 4 miles from either extremity, surmounted by a series of locks, within a space of less than 2 miles. Among the hills which are in this part, is a chain of natural locks, which serve as reservoirs for supplying the canal. This is the scene of the disaster.]

The Port of Glasgow revenue, in the last year, exceeded that of the former year by the sum of £50,725; an additional staff of dock-clerks, &c., is talked of as being absolutely necessary.

The Business of the Port of Suez, there is some probability, is about to be transferred to the Bay of Ataka, some 10 miles south of the present landing-place; Mr. Brunel has been requested by the Egyptian viceroy to visit Suez on his return to Cairo, and to give his professional opinion as to putting into execution this, as it appears, long talked-of project.

The Falmouth Docks and Harbour Bill has (28th January ult.), passed the Examiners for Standing Orders.

The Gateshead Quay Bill passed (5th February ult.), the Committee of Standing Orders.

The Saint George's Harbour Act (Amendment) Bill is postponed.

The Charleston Harbour (and Railway) Bill has passed the Standing Orders Committee.

The Chichester Harbour and Embankment Bill ditto.

The Breconshire Canal (and Railway) Bill ditto.

Mersey [Additional] Docks.—The Liverpool Chamber of Commerce (14th February ult,), agreed to memorialise the Board of Trade in support of the Bill promoted by the Mersey Docks and Harbour Board for power to borrow £300,000 for additional dockworks on the Liverpool side of the Mersey.

The Mauritus Dock Company have begun the excavations for a vast Dry Dock at Port Louis, Mauritius, to facilitate the recently-established Mail-Service between that Port, Australia, and England. The new dock is to be 350 ft. long, 80 ft. extreme breadth; 60 ft. mean, and 40 minimum breadth; depth, 25 ft.; capable of easily taking in the largest sized vessels extant. The pumping machinery is being constructed by Messrs. Gwynne and Co., Engineers, London. Engines of 100 H.P. will work three centrifugal pumps, discharging 12,000 gallons of water per minute; and the dock, containing 13,000 tons, will be entirely empted in 2½ hours. An additional smaller pump, worked by a separate engine, will keep the dock dry during repairs to vessels. The Company have likewise a forge, and every requisite appliance for the repairs of iron vessels. Excavations (per contract) to be finished in a year; but vessels, it is expected, will be received in about nine months.

The Southampton Docks' recent report, shows a net revenue for the half-year ending 31st December, of £7,041. The accident to the north wall of the inner dock has occasioned much delay in the completion of that dock, and some loss of revenue to the Company; but it is expected the dock may be opened for the reception of vessels in the course of next month. The extra charge, in consequence of strengthening the works, will make the cost of the docks amount to £50,000, and will require an additional sum of £10,000, to be met by creation of 5 per cent. preference stock.

Liverpool Docks, and the Steam-Trade.—The Mersey Dock Board (17th February, ult.) are about to erect two carrier-docks, at the north end of Liverpool, comprising 4½ acres of water-space, a half-tide basin of 4 acres, and the necessary passages and locks. Estimated cost of works, 213,956*l.*; the plans include a lock to facilitate the loading of timber; and a railway jetty, also for this purpose. Also, an addition to the Huskisson dock for the accommodation of the steam trade; namely, a branch 1,180 feet in length, by 250 in width; and giving an additional water-area of about 6¾ acres. Estimated cost 70,000*l.*

The Jarrow Docks, according to an assurance given to a recent meeting of the North-Eastern Railway shareholders, will admit the largest vessel that has ever entered the Tyne.

EMBANKMENTS.

The Chichester Harbour Embankment Bill has passed the Examiners for Standing Orders.

The Rhine.—On the 10th February ult., the Prussian Chamber of Deputies were occupied with the petition of a landed proprietor on the banks of the Rhine, complaining of the damage done to the river-bank by the waves of the steamers. From 16,000 to 18,000 *morgens* (*i.e.* from 12,000 to 14,000 acres), had disappeared from the right bank of the Rhine; and the shoaling of the river was proceeding at an alarming rate. Valuing the *morgen* at only 300 thalers, the loss would amount to nearly five millions. The remedy suggested by the petitioner, was to face the river-bank with stone, or, if that could not be done, to prohibit the navigation by steamers, whenever the water in the river has arisen beyond a certain height. The committee, after deliberation, decided to demand the order of the day on this petition.

MINES, METALLURGY, &c.

The Amount of Coal Raised Annually in Great Britain is 68,000,000 tons. This quantity, it has been calculated, is equal in bulk, to a solid globe 1,549·9 ft. in diameter; or, if piled into a square-based pyramid (the base occupying 40 acres), they would reach to the enormous height of 3,356·914 ft.

In Tasmania, a New Gold-field is announced as having been discovered at Nine-mile Creek. A "prospecting" party washed out two bucketfuls of earth, and, it is asserted, found several nuggets of fine gold; the largest, about the size of a pea; also a beautiful specimen of auriferous quartz. The discovery was communicated to both houses of the (Colonial) legislature, in a letter to the Colonial Secretary from George Town, dated 27th October ult.

The Tasmanian Legislature have offered a reward of £5,000 to the discoverer of a "paying gold-field."

Port Philip and Colonial Gold Mining Company, up to the 15th December ult. Quantity of quartz crushed during November (four weeks), 675 tons. Yield of gold, 2,085 ozs. Amount received for crushing, &c., £4,120 7s. Expenditure, £2,021 11s. 8d.: showing a profit of £2,098 15s. 4d. Cost of reduction, therefore, £1 4s. per ton.

The Clunes Company have at length got their pumping and winding-engine to work; and are about opening out the quartz veins at the deeper level of 230 ft.

Total Exports of Coal, during January, 1859, from the various Ports of the United Kingdom, 293,922 tons, being an increase of 8,050 over exports of 1858. The Northern Ports exported 137,082 tons; Yorkshire Ports, 17,454; Liverpool, 30,290; the Seven Ports, 94,373; Scotch Ports, 14,793.

Tampering with Davy-Lamps.—Three pit-lads, employed at Horton Colliery, were (17th February ult.) ordered by the South Shields magistrates to be locked up for three days, charged with tampering with their Davy-lamps down the pit. They had unlocked their lamps out of pure mischief, and of course endangered the lives of the pitmen.

The Dun Mountain Mining Company, at a recent meeting, authorised the discontinuance of their copper ore works, and the discharge of all persons connected with the Company. With regard, also, to the raising of chromate of iron, it was declared to be doubtful whether, from the information as yet received by the Board, the mineral in question would prove remunerative as an article of importation.

The United Mexican Mining Association are urging claims for damage at the Haciendas of Dolores, and Duran, committed by the troops under General Pueblita, in an attack on the City of Guanaxuato; which have been repudiated by the recent Zuluoga Government; but the English minister at Mexico, and the Consul at Guanaxuato, have taken the matter up, and are urging payment of the demands.

The New Miner's Safety-Lamp, patented by Messrs. Wilkins and Co., Lighthouse Engineers to the Trinity House, is an improvement on that of Davy, as, in the new lamp, the flame is surrounded completely with glass, or talc, whilst in the former, the gauze is continued from the level of the wick upwards, thus obscuring the light; in the improved construction, it commences some 3 inches higher. The draught is maintained by the external air passing through the body of the oil-can, by means of four large tubes around the wick, and communicating with a lower chamber in connection with the external air, through the meshes of a fine metal-gauze; whilst, in the Davy lamp, the air is admitted on a level, and directly opposite the wick.

The Fraser River Mining prospects (according to late advices, to the 27th December ult.), are favourable.

METALLURGY.

The "Acadian Charcoal-Iron" Company have authorised the issue of 2,000 of their unallotted shares as preference shares; dividend not to exceed 8 per cent.

The Wallsend Blast-Furnaces will commence again forthwith. Extensive alterations have been made: new hoist-engine and engine-house, storehouses and blacksmiths' shops have been built; the large engines have been entirely overhauled and repainted. Chief foreman of the works, Mr. James Meares.

The British and Foreign Smelting Company [limited] is to be "wound up," an order to that effect having (5th February ult.) been passed by Mr. Commissioner Fonblanque, in the Court of Bankruptcy. The business had been carried on at Bow: nominal capital, £10,000, of which £1,380 had been paid up. The assets had dwindled down to £1 13s. 4d.

Melbourne Assay-Office.—Quantity of gold melted during November last, 40,378 ounces.

APPLIED CHEMISTRY.

Glycerine (the sweet principle of oil) is now, under a recent patent, manufactured by forcing dry steam, at a temperature of about 400 deg. Fahr. through spent soap-lees. By this means the glycerine is evaporated, the salts being left to deposit themselves in the containing vessel. Glycerine is also, by another recently-patented process, used in the preparation of paper; mixed, in the proportion of about 5 per cent., with the pulp at one stage of the manufacture, it is understood greatly to improve the texture of the paper, by rendering it supple and soft to the touch.

The Permanganate of Potass is now considered to be one of the most efficacious disinfectants and antiseptics in modern use.

"Voltaic Narcotism," a new discovery, is based on the application of the electrical forces to the introduction of narcotics into parts, locally, where it is desired to produce insensibility to pain. In practice, Dr. Richardson, the discoverer of the process, applies a narcotic mixture to the part; and then covering this part with a plate connected with the positive pole of the voltaic battery, and connecting the negative pole at an adjoining point, he produces complete insensibility of the parts included. The more painful surgical operations, as amputation, &c. &c., may thus, it is confidently hoped, be divested of their usual terrors.

LIST OF NEW PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 2nd November, 1858.

2438. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Railway breaks.

Dated 1st December, 1858.

2740. R. Laming, Hayward's-heath, Sussex—Purifying gas.

Dated 3rd December, 1858.

2766. E. S. Jones, 13, Marylebone-street, Golden-square—Cornets, trumpets, and similar musical wind instruments.

Dated 10th December, 1858.

2832. J. Bethell, 8, Parliament-st.—Apparatus for the preservation and coloring of wood.

Dated 21st December, 1858.

2916. A. S. Beliard, Bordeaux, France—Machine for pumicing felts, tissues, and skins.

Dated 22nd December, 1858.

2920. R. Clegg, Islington, F. Angerstein, Kennington, and G. Ferry, Hackney—Imparting reciprocating motion to machinery.

2924. M. Renney, Queen-st., Dublin—Bridges.

Dated 27th December, 1858.

2954. J. Radley, 22, Upper Sackville-street, Dublin—Cooking apparatus.

2962. F. W. Turner, Foxhole Colliery, Swansea—Steam engines, condensers, and steam boilers.

Dated 28th December, 1858.

2968. A. Lyons, Finsbury—travelling bags.

Dated 30th December, 1858.

2984. H. C. Vion, Paris—Obtaining atmospheric electricity, and its industrial applications.

Dated 31st December, 1858.

2999. J. H. Johnson, 47, Lincoln's-inn-fields—Boots and shoes.
3001. M. D. Wyatt, Guildford-street, Russell-square—Tiles and tessaræ and other wall coverings.
3003. J. Lees and W. Heap, Park-bridge, near Ashton-under-Lyne, Lancashire—Machinery for punching square holes in the ends of rollers and other articles.
3004. J. H. Sievers, 48, Rathbone-place, Oxford-st.—Apparatus for tightening and releasing the belly bands of riding saddles.
3005. F. W. A. Casper and G. H. Schmahl, 152, Rue du Faubourg St. Martin, Paris—Using spart or Spanish broom in manufacturing seats of all descriptions.
3007. J. H. Johnson, 47, Lincoln's-inn-fields—Production and casting of steel.

Dated 1st January, 1859.

1. J. T. Pitman, 67, Gracechurch street—Making and fitting bungs to casks and other vessels.
2. H. C. Traphagen, New York, U.S.—Skirts for ladies.
3. A. Anderson, Lancaster, U.S.—Governors for machinery.
4. B. J. Gosteau, 2, Rue Ste. Appoline, Paris—Gridiron.
5. J. E. Drouot, 2, Rue Ste. Appoline, Paris—Bakers' ovens.
6. W. Footman, 15, Water-street, Strand—Breaks for retarding and stopping railway trains, carriages or other vehicles.
7. J. Oliver, White Bank, near Chesterfield, Derby—Lubricators for steam engine cylinders.
8. J. Walkland, Green-lane, Sheffield—Lighting cigars and tobacco.
9. J. Garforth, Dukinfield, Chester—Steam engines.
10. H. Ashworth, Littleborough, Lancashire—Power-looms for weaving.
11. R. Smith, Beith, Ayr, N.B.—Casting.
12. P. E. Guérinot, 60, Boulevart de Strasbourg, Paris—Apparatus to railway locomotives, waggons and carriages, for the purpose of lessening the effect of concussion in the event of collision.
13. W. Eccles, 34, Surrey-street, Strand, Westminster—Apparatus for regulating the tension of the twist threads or warp whilst it is weaving in power-looms into cloth.
15. A. Prince, 4, Trafalgar-square, Charing-cross—Cylindrical presses.
16. W. A. Von Kanig, Leipsic, Saxony—Apparatus for cultivating land.
17. J. Harris, Hanwell, Middlesex—Apparatuses for regulating the pressure and flow of steam, water, and other fluids.
18. I. Wood, Charing-cross—Cutting and finishing corks.
19. G. Skinner, Stockton-on-Tees, Durham, and J. Whalley, South Stockton-on-Tees, Yorkshire—Ornamental and other tiles.
20. J. Brown, jun. Rotherham, Yorkshire—Buffers, draw springs, and bearing springs.
21. G. T. Bousfield, Loughborough-park, Brixton, Surrey—Machinery for forming dough into cakes or bread crackers.
22. A. L. Lévèque, Paris—Apparatus for subduing or stopping runaway or restive horses.
23. J. B. Morgan, Liverpool—Propelling navigable vessels.

Dated 3rd January, 1859.

24. J. Luis, 1B, Welbeck-street, Cavendish-square—New economical candles.
25. R. Tempest and J. Tomlinson, Rochdale, Lancashire—Machines for preparing cotton and other fibrous materials.
27. C. B. Blyth, Dundee—Machinery for preparing and treating jute, hemp, flax, and other fibrous materials.
28. E. Balchin, Myton-gate, Hull—Construction of projectile, applicable to the whale fishery.
29. W. Renton, T. Renton, and W. Binns, Leeds—Raising the nap or pile of textile fabrics.
30. J. Furnival, Leamington, Warwickshire, T. Furnival, Cobridge, J. Derbyshire, Longton, and F. J. Emery, Burslem, Staffordshire—Apparatus for supporting articles of china and earthenware in kilns and ovens.

Dated 4th January, 1859.

31. L. J. Higham, Edmund-place, London—For obtaining submarine electrical conduction.
32. J. Buchanan, Greenock, Renfrewshire, N.B.—Oil cans or lubricating apparatus.
33. J. B. Joyce, Bradford, Yorkshire—Apparatus applicable to wool combing.
34. W. Hood, 68, Upper Thames-street—Racks and water cisterns for stables.
35. A. Bedborough, Southampton—Chimney cowl and ventilator.
36. C. de Forest, Leicester-square—Springs for carriages, and other uses.

Dated 5th January, 1859.

37. F. Clark, King-street, Bloomsbury—Connecting knobs and handles to the spindles of locks and latches.
38. W. Draper, 2, Gordon-terrace, Holland-road, Brixton—Machinery for printing on paper and other fabrics.
39. J. Howard, Bedford—Lever-neck plough.
40. R. Rumney and W. S. Macdonald, Manchester—Printing and dyeing woven fabrics and yarns or threads.
41. A. V. Newton, 66, Chancery-lane—Apparatus for separating metals from their ores.

Dated 6th January, 1859.

43. J. Kirkman and I. Grundy, Bolton-le-Moors, Lancashire—Counterpanes, and other textile fabrics of similar character.
44. G. Bury, Everton, near Liverpool—Apparatus for effecting the pick in power looms for weaving.
45. H. G. Coombes, 17, Union-street, Borough—Constructing railings, bars, gates, gratings, columns, and all other builder's work of a like nature or description.
46. E. T. Hughes, 123 Chancery-lane—Apparatus for preparing cotton and other fibrous materials to be spun.
47. W. Renton, T. Renton, and W. Binns, Leeds—Finishing woollen and other fabrics.
48. J. Aspinall, Great Tower-street—Machines for the manufacture of bolts, rivets, and spikes.
49. J. H. Johnson, 47, Lincoln's-inn-fields—An improved textile fabric, applicable to the manufacture of varnished cloths, and to other purposes.
50. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for boring or working of stone.

Dated 7th January, 1859.

51. W. Spence, 50, Chancery-lane—Mode of taking photographic pictures on wood.
52. I. Holden, St. Denis, near Paris, and A. Holden, Bradford, Yorkshire—Apparatus employed in preparing and combing wool and other fibres.
53. E. Heywood, Halifax—Weaving.
54. J. J. Florance, Paris—Reels or spooling-wheels.
55. G. K. Geyelin, London—Universal gas burner regulator.
56. A. Barclay, Kilmarnock, N.B.—Electric and magnetic telegraphs.
57. J. Paterson, Wood-street—Bands and belts for the waist.
58. H. Reynolds, Denmark-hill, Surrey—Refining and decolorising saccharine substances.
59. W. E. Newton, 66, Chancery-lane—Machinery for winding, twisting, and doubling fibrous materials.

Dated 8th January, 1859.

60. H. Harden, Dundalk, Ireland—Fire bars for steam boiler and other furnaces.
61. C. F. Vasserot, 45, Essex-street, Strand—Chain and bucket pump.
62. D. Friedlander, Manchester—Smoking pipe.
63. T. B. Hubbell, Castle-street—Trap for rabbits, mice, and other animals.
64. F. Versmann and A. Oppenheim, Bury-court, St. Mary Axe—Treatment of various substances to render the same uninflammable.
65. A. W. Williamson, University College, London—Condensers for steam engines and other purposes.
67. W. Clark, 53, Chancery-lane—Purifying natural phosphates of lime.
68. E. Cobbold, Hendon, Middlesex—Instruments for writing and marking.
69. J. T. Forster, Holland-road, Kensington—Bed berths.
71. W. A. Lyttle, Secretary's Office, General Post Office, London—Taking the place of springs in many, if not all, of the combinations into which they enter, and also for equilibrating a varying force or weight.

Dated 10th January, 1859.

72. R. D. Clegg, Manchester—Signalling apparatus.
73. L. A. Normandy, jun., 67, Judd-street—Clarifying resinous substances.
74. T. J. Claxton, Montreal, Canada—Boots and shoes.
75. F. Lehr, Hoboken, New Jersey, U.S.—Manufacturing metallic ribs for umbrellas, and other articles.
76. J. S. Margetson, Cheapside—Box or case suitable for hats and other purposes.
77. J. White, Finchley—Cleansing or purifying air.

Dated 11th January, 1859.

79. E. Agneni, 29, Devonshire-street, Queen-square, Bloomsbury—Increasing particularly the effect of decorative pictures, landscapes, drawings, and prints, through looking glasses.
80. C. M. Kernot, Gloucester-house, West Cowes, Isle of Wight—Purifying and decolorising paraffine.
81. J. Biers, jun., 38, Rochdale-road, Kentish-town—A self-acting carriage wheel brake.
82. B. Robbin, Yarmouth, Nova Scotia—Machinery for working pumps.
83. W. Tillie, Londonderry—Manufacture of shirts and shirt fronts.
84. D. E. Hughes, Northampton-sq.—Mode of insulating electrical conducting wires.
85. B. J. Rubenstein, London—Dentistry.
86. R. Hawthorn and W. Hawthorn, Newcastle-upon-Tyne—Apparatus for promoting combustion and preventing smoke in coal-burning locomotives.
87. C. W. Siemens, John-street, Adelphi—Supports for electric telegraphic line wires, and in tools or apparatus to be used in the construction of such supports.
88. F. Versmann and A. Oppenheim, Bury-court, St. Mary Axe—Rendering substances non-inflammable.
89. N. P. Burgh, Sheerness—Steam engines.

Dated 12th January, 1859.

90. P. Bouché, 57, Rue de Bretagne, Paris—Mechanically raising up the gowns of ladies and young ladies.
91. W. Bray and W. T. G. Bray, Folkestone—Locomotive and traction engines.
92. W. Oliver, Shadwell—Boats, and the mode of propelling them.
93. J. Thomson, Dundee—Manufacture of rugs.
94. J. Hands, Elgin-crescent, Notting-hill—Preparing skins intended to be converted into leather.
95. J. Gibbons, 345, Oxford-st.—Fixing door and other knobs.
96. S. Canning and H. Clifford, Leadenhall-st.—Machinery for paying out submarine telegraph cables.
97. T. Elwell, Paris—Governors for steam engines and other motive power engines.
98. W. McNaught, Manchester, and W. McNaught, Rochdale—Steam engines and apparatus connected therewith.
99. S. Phillips, Moseley, Worcestershire—Fastenings for securing windows, shutters, and doors.
100. R. Mushet, Coleford, Gloucestershire—Improved metallic alloy.
101. R. Mushet, Coleford, Gloucestershire—Manufacture of cast steel.
102. C. N. May, Devizes, Wiltshire—Sluice valves.
103. C. Beslay, 52, Rue St. Sebastien, Paris—Covering iron or steel with tin, zinc, or lead, by electrical deposit.

Dated 13th January, 1859.

104. C. N. May, Devizes, Wiltshire—Heat indicator.
105. R. A. Lightoller, Chorley, Lancashire—Apparatus for spinning cotton or other fibrous materials.
106. W. Bennetts, Tuckingmill, Cornwall—Mechanism used for preventing accidents when raising or lowering skeps or baskets.
107. W. H. Crispin, Marsh-gate-lane, Stratford—Construction of ships and other sailing and steam vessels.
108. H. Critchley and S. Elston, Bury, Lancashire—Pistons for steam engines or other purposes.
109. G. Scopes, Needham Market, Suffolk—Communicating motion to cots, cradles, and other articles for children's use.
110. J. Picksley and R. Sims, Bedford Foundry, Leigh, Lancashire—Lawn mowing machines.
111. W. H. Morrison, Nottingham—Wind musical instruments.
112. D. L. Banks, Kennington, Surrey—Constructing a travelling suspension rail or roadway, applicable, among other uses, as a bridge and lifting agent.
113. J. J. Stevens, Darlington Works, Southwark—Railway signal apparatuses.
114. F. J. Manceau and E. N. Vieillard, Paris—Breech-loading fire-arms and cartridges.
115. J. Grist, Beazley-crescent, Old Ford, Middlesex—Machinery for cutting and shaping staves and heads for casks.
116. W. A. Chadwick, Wandsworth-road—Instrument for teaching the intervals of musical scales.
117. W. Wilson, Newcastle-on-Tyne—Machinery for felting bodies of hats and bonnets.
118. T. Herbert and E. Whitaker, Nottingham—Manufacture of warp lace.
119. O. Rowland, 4, Chapel-st. west, May-fair—Laying electric telegraph wires in streets.
120. J. Barrans, 2, Caledonian-terrace, Queen's-road, Peckham—Traction and portable steam engines.
121. T. Sampson, Calle Cartanos, 8, Barcelona, Spain—Apparatus for feeding steam boilers with water.

Dated 14th January, 1859.

122. S. Holt, Manchester—Manufacture of woven silk fabrics.
124. W. Craft, 12, Cambridge-road, Hammersmith, and T. Wilson, Bradmore-house, Chiswick—Drawers and napkins.
125. W. Davis, 2, Ann-st., Globe-fields, Mile-end—Sluice valves.
126. J. Dauglish, M.D., Tunbridge Wells—Obtaining carbonic acid gas.
127. R. Romaine, Chapel-st., Bedford-row—Portable railway.

Dated 15th January, 1859.

128. J. Eccles, Blackburn, Lancashire—Manufacture of articles from clay earths for building purposes.
129. W. H. E. McKnight, Lydiard-house, near Swindon, Wiltshire—Boiler applicable to all heating purposes.
130. P. A. Viette, 25, Faubourg de Schaerbeck, near Brussels—Inks applicable for engraving and lithographic purposes.
131. D. L. Banks, 3, Kennington-row, Kennington-park—Constructing a travelling suspension rail or roadway, to be used for the cultivation of land.
132. R. Mushet, Coleford, Gloucestershire—Manufacture of cast steel
133. W. Betts, Wharf-road, City-road—Manufacture of Capsules.
134. R. Mushet, Coleford, Gloucestershire—Manufacture of cast steel

Dated 17th January, 1859.

135. W. Morgan, 31, Grafton-st., Fitzroy-sq.—Printing and stencilling.
136. T. Edwards, Liverpool—Letter boxes and other like receptacles.
137. J. Montgomery, New York, U.S.—Construction of the hulls of steam and other vessels.
138. E. T. Hughes, 123, Chancery-lane—Sowing seed.
139. P. A. de S. S. Sicard, Paris—Converting cast iron into steel.
140. S. T. Cooper, Upper Clapton—Artificial light.
141. W. E. Newton, 65, Chancery-lane—Sewing machines.

142. E. Brooks, 43, Edward-st., Dorset-sq.—Locks.
143. R. G. Salter, Alphington, Devonshire—Apparatuses for collecting or picking up letters, papers, and other articles requiring to be stamped or printed.
144. G. Collier and J. Collier, Halifax — Apparatus for washing and drying wool and other fibres.
145. R. Mushet, Coleford, Gloucestershire — Manufacture of cast steel.

Dated 18th January, 1859.

146. J. Luis, 1b, Welbeck-st., Cavendish-sq. — A new machine for putting on, equalising, and drying the colours on paper for hangings, book-binding, boarding and fancy paper of every description.
147. W. Newman, Aston, near Birmingham. — Furniture for window and other blinds.
148. J. Foster, Lancaster — Apparatus called "spinning frames" and "roving frames" employed for spinning and roving flax
149. G. Hamilton, Liverpool—Treating rosin and resinous substances to obtain products therefrom.
150. H. Gallon, J. H. Bean, and S. Lumb, Leeds—Machinery for slotting, mortising, tenoning, and cutting wood, iron, and other substances.
151. C. D. Archibald, Rusland-hall, Lancashire—Generating force.
152. R. A. Brooman, 166, Fleet-st.—An improved silk thread.
153. R. Garrett, Jun., and J. Kerridge, Leiston-works, Saxmundham, Suffolk—Combined thrashing and dressing machine
154. J. Fawcett, Kingston-upon-Hull—Preparation of food for cattle and horses
155. R. Bradley and W. Craven, Westgate Common-foundry, Wakefield—Apparatus for manufacturing bricks, tiles, and other similar articles.
156. W. Trotter, South Acomb, Northumberland—Reaping machines.
157. J. H. Johnson, 27, Lincoln's-inn-fields — Air pistols and guns.

Dated 19th January, 1859.

159. W. A. F. Powell, Bristol—Stopping or closing jars and bottles.
160. P. A. Sparre, 50, Chancery-lane — Manufacture of paper, suitable for bank-notes and similar articles.
161. T. Clarke, Litchurch-lane, near Derby—Manufacture of core barrels for piles or columns used either for railway piles or columns.
162. E. T. Hughes, 123, Chancery-lane — Apparatus for measuring and sorting silk and other textile materials.
163. J. Whitehead, Halifax—Machinery for the manufacture of purled wire.
164. E. Stevens, 5 Patriot-row, Cambridge-road—An improved cooking utensil.
165. T. A. Evans, 15, Queen's-road, Bayswater, and W. J. H. Rodd, 38, Arlington-square, Islington—A new method of advertising.
166. W. Poupard, Blackfriars-road—Wheel-skid or shoe.
167. J. H. Johnson, 47, Lincoln's-inn-fields—Manufacture or production of lasts, boot-trees, and clogs.

Dated 20th January, 1859.

170. J. C. Reid and W. Milner, Liverpool—Construction of ships and vessels.
171. H. Hilliard and T. Chapman, Glasgow—Table knives and table-knife sharpeners.
172. A. Lindo, Batignolles, France—Manufacturing soap.
173. W. Woolfe, Gloucester—Implements for ploughing, tilling, and paring land.
174. E. T. Hughes, 123, Chancery-lane—Preventing incrustation in steam boilers or other vessels.
176. S. Phillips, Moseley, Worcestershire—Sliding sashes, shutters, or doors.
177. W. E. Newton, 66, Chaucery-lane—Apparatus for measuring water and other liquids.
178. T. Greenwood, J. Batley, and J. Dockray, Leeds—Machinery for converting hemp and flax fibres into yarn, twine, ropes, and cordage.
179. J. Bent, Newhall-st. Birmingham—Clasps or fastenings applicable for belts, garters, and other purposes.
180. J. Shanks, Arbroath, N.B.—Mowing machines.
181. J. L. Clark, Haverstock-hill, and J. Muirhead, Gloucester-road, Regent's-park—Electric telegraphs and apparatus used in working the same.
182. H. Sagar, Broughton, near Manchester, and A. Schultz, Paris—Producing pink shades on cotton fabrics or yarns.

Dated 21st January, 1859.

183. T. Richardson, 20, New Bridge-st. Newcastle-on-Tyne —Manufacture of manure.
184. S. Osler, Great Yarmouth, Norfolk, and J. B. Balcombe, Brixton, Surrey—Apparatus for treating fish, so as to adapt it for manure.
185. L. Le Prince, 261, Regent-st.—Ladies' boots and shoes.
186. G. B. Harkes, 1, Montague-terrace, Trinity-square, Southwark—Machine for washing, wringing, and mangling.
187. G. Ellis, 4, Collier-st., Pentonville—Muffs, to be called the patent reticule muff.
188. J. Hick and W. Hargreaves, Bolton-le-Moors, Lancashire—Construction of steam boilers.
189. R. Howell, Smethwick, Staffordshire, and R. J. Wilder, Birmingham—Taps or stop-cocks.
190. C. O'Hara, 4, Upper Seymour-st., Hyde-park—Propellers for propelling steamboats and vessels.
191. W. Wells, Greenland, near Halifax—Apparatus employed in spinning and twisting cotton, and other fibrous substances.
192. A. Davenport, Birmingham—Regulating burner for gas.
193. J. Childs, Windsor-house, Windsor-road, Putney—Applying heat in the manufacture of artificial gums and teeth.
194. J. H. Hume, Broughty Ferry, Forfar, N.B.—Warming apparatus for the feet.
195. A. J. A. Gautier, J. G. Dumay, and J. T. Persin, Paris—Improved manure.
197. J. Newman, Birmingham—Manufacture of chains.
198. B. Lauth, Surrey-st., Westminster—Machinery for rolling plates, bars, rods, and shafts.
199. J. Edwards, 77, Aldermanbury — Manufacture of buckles.

Dated 22nd January, 1859.

201. D. Moseley, Chapel Field Works, Ardwick, Manchester —Manufacture of india-rubber thread.
202. B. Templar, Bristol—Umbrellas and parasols.
203. E. Dorsett, 76, Old Broad-st., London, and J. B. Blythe, Minerva-place, New-cross, Kent—Distillation of oil from coal tar.
204. M. Henry, 84, Fleet-st.—Apparatus for manufacturing corks and bungs.
205. W. E. Newton, 66, Chancery-lane—Machinery for cutting files.
206. T. W. Rammell, 16, Spring-gardens— Atmospheric propulsion.
207. C. Sharps, Philadelphia, Pennsylvania, U.S.—Breech-loading repeating-fire-arms.
208. R. Barter, St. Ann's-hill, Blarney, Cork — Heating and ventilating buildings.

Dated 24th January, 1859.

209. W. C. Homersham, Adelphi-terrace, Strand—Floating gridirons or stages for repairing ships.
210. R. Mushet, Coleford, Gloucestershire—Manufacture of cast steel and iron.
211. R. Mushet, Coleford, Gloucestershire—Manufacture of cast steel.
212. R. A. Brooman, 166, Fleet-st.—Pumps.
213. J. Laubereau, Paris—Air engines.
214. J. Smith and W. H. Smith, 8, Upper Fountain-place, City-road — Manufacturing paper, and producing watermarks and devices thereon.
215. J. Savory and W. R. Barker, 143, New Bond-street—Bottles for medicines and poisons.
216. J. Fowler, jun., Cornhill, R. Burton, Kingsland, Middlesex, D. Greig, New-cross, Kent, and J. Head, Newcastle-on-Tyne—Agricultural implements.
217. A. Warner, 31, Threadneedle-st., and W. Tooth, Sumner-st., Southwark—Manufacture of iron and gases.
218. J. Proger, 13, Trinity-st., and D. Davies, Stuart-st., Bute Docks, Cardiff—Lanterns used on board-ship to signal to the steersman.
219. Right Hon. James, Earl of Caithness, Hill-st.—Permanent way of railways.
220. M. Swan, Henstridge-villas, St. John's-wood—Ballasting ships.
221. W. Tasker, jun., Waterloo Iron Works, near Andover, Hants—Ploughs.

Dated 25th January, 1859.

223. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for cutting and shaping wood.
224. R. Bodmer, 2, Thaives-inn, Holborn—Improved resin and resinous substances.
225. W. Cutts, Oldham—Manufacture of bobbins, spools, and cop tubes.
226. W. Hodgson and H. Hodgson, Bradford—Apparatus for preparing and spinning wool and other fibrous substances.
227. J. White, Finchley, Middlesex—Apparatus to facilitate respiration under water.
228. W. Andrews, 30, Cornhill—Electric telegraphs.
229. F. J. Jones, Aldermanbury—Shirt-fronts.
230. H. Brecknell and J. Dyer, Bristol—Cocks and valves.
231. I. Woodcock, Commercial-st., Spitalfields—Barometer and thermometer dials.
232. B. J. Spedding, 9, Cross-st., Birkenhead—Apparatus for generating and regulating gas.
233. C. G. Kelvey and W. Holland, Rock Ferry, Birkenhead—Escapement for chronometers and other time-keepers.
234. W. E. Newton, 66, Chancery-lane—Life preserving vests.

Dated 26th January, 1859.

235. W. R. Alexander, Glasgow—Furnaces and apparatus for the manufacture of sugar.
236. I. Hammond, Winchester—Breech-loading fire-arms.
237. O. Hussey, Baltimore, U.S.—Construction of ships' blocks.
238. D. Graham, Wapping, Middlesex—Method of driving centrifugal machines.
239. J. Wells, Keighley, near Yorkshire, and W. Crouch, Sutton, near Keighley—Coupling for railway carriages and analogous uses.
240. F. C. C. Paulsen and A. Alsing, Emmett-st., Limehouse —Preparing beverages usually called punch.
241. M. Fernandez, 2, Devonshire-square, Bishopsgate-st. without—Straw and hay cutters.
242. J. Kerr, 17, Bedford-terrace, Trinity-sq., Southwark—Revolving fire-arms.

Dated 27th January, 1859.

243. J. Mercer, Liverpool—Process of currying leather.
244. W. Ager, Rhorsburg, U.S. — Machinery for cleaning rice.
245. T. Hartshorne, West Bromwich, Staffordshire—Metal to be used for making journey brasses for mills rollers, and all kinds of shafts and machinery.
246. E. Dixon and H. Whittaker, Preston—Weaving textile fabrics.
247. J. Meacham, Birmingham—Pens and penholders.
248. H. D. P. Cunningham, Bury, near Gosport—Rig of ships or vessels.
249. H. Rawson, Leicester—Machinery for preparing wool and other fibrous substances.
250. J. Buckingham, Walworth-common, Surrey, and G. Salt, Saltaire, near Bradford — Adaptation of drawing and other rollers employed in drawing and compressing fibres.
251. E. T. Hughes, 123, Chancery-lane—Biscuits.
252. G. F. Bradbury, Oldham, and J. J. King, Glasgow—Apparatus applicable to sewing machines.
253. W. Crowther, Leeds—Manufacture of prussiate of potash or soda.
254. J. Gathercole, Bath-terrace, Camberwell New-road — Machinery for manufacturing envelopes and paper bags.

Dated 28th January, 1859.

255. I. Zacheroni, Liverpool—Method of preventing the escape of smoke into the atmosphere.
256. W. Robertson, Manchester—Propelling boats on canals and lakes of moderate depth.
257. G. Bartholomew, Linlithgow, N.B.—Shoes for horses.
258. C. E. Amos, the Grove, Southwark, and J. Francis, Bangor, North Wales—Water pressure engines.
259. F. Prince, 138, New Bond-st.—Breech-loading gun.
260. W. Yates, Mary-st., Bromley—Furnaces.
261. R. Griffiths, 69, Mornington-road — Regulating the pressure of steam in steam boilers.
262. H. Watson, High Bridge Works, Newcastle-upon-Tyne—Manufacture of Knotter-plates.
263. A. Barclay, Kilmarnock, Ayr, N.B.—Applying electricity and magnetism.

Dated 29th January, 1859.

264. L. Leisler, Glasgow—Extracting metallic copper from the pyrites residuum of vitriol works.
265. J. Lane, West Bromwich, Staffordshire—Improved machiuery for the manufacture of screws.
266. J. MacKenzie, St. Martin's-le-Grand—Method of operating ventilating valves.
267. J. Marine, Stockholm—An inodorous closet or commode.
268. G. Davies, 1, Serle-st., Lincoln's-inn — Apparatus applicable to measuring, and consuming gas for illumination.
269. H. Grissell, Regent's Canal Iron Works, Eagle Wharf-rd.—Machinery for moving ships or vessels on slips or inclined ways.
271. J. Meacham, Birmingham—Apparatus for clasping and closing books, purses, reticules, and other similar articles.

Dated 31st January, 1859.

272. T. P. Smith, Stanmore, Middlesex—An apparatus for guiding or directing the pen or pencil in writing or drawing.
274. J. Raywood, Wentworth, Yorkshire—Method of working sewing machines.
276. J. Robertson, Glasgow—Imp. in details, by which motive force is transmitted in machinery.
278. J. P. Booth, Cork—Ventilating ships.

Dated 1st February, 1859.

280. J. Grimond, Manchester—Hearth rugs.
282. J. Hosking, 5, Catherine-terrace, Gateshead-on-Tyne, and T. Cock, Cleator-Moor, near Whitehaven—Furnaces or fireplaces.
286. M. A. Walker and R. Walker, Birmingham—Manufacture of percussion caps.
288. T. P. Purssglove, Battersea, Surrey—Barometers.
292. C. Crockford, Holywell, Flintshire—Method of producing metallic sulphates.
294. E. H. Bentall, Heybridge, near Maldon, Essex—Machinery for grinding or pulverizing various substances.

Dated 2nd February, 1859.

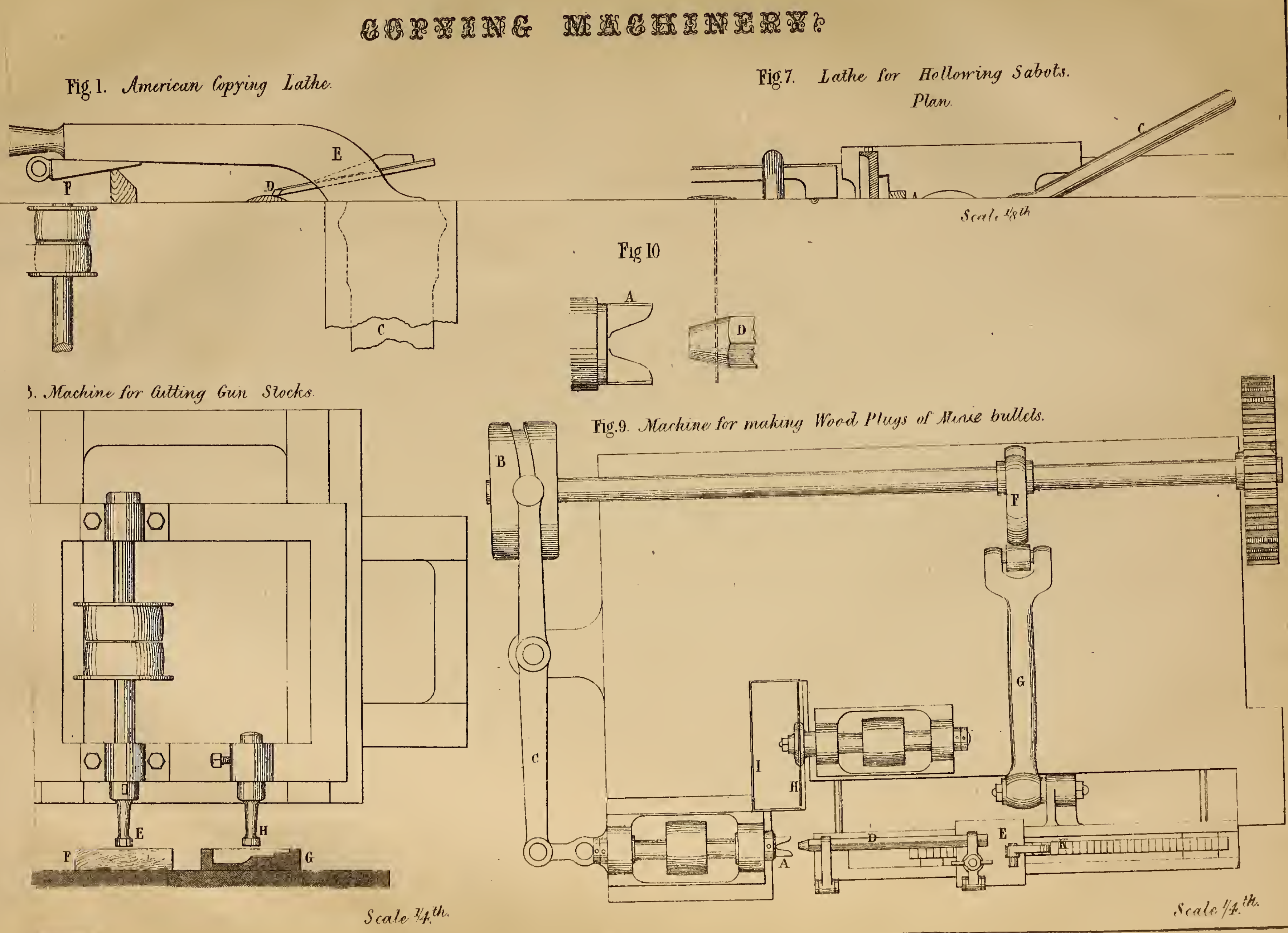
296. E. E. Allen, Brompton-row — Stereoscopic apparatuses.
298. R. Lancaster, Orrell, near Wigan—Ventilating coal and other mines.
300. J. R. Cooper, Birmingham — Breech-loading fire-arms.
302. J. Buncher, Birmingham — Manufacture of eyes or fastenings for stair rods.
304. J. Hirst, jun., and J. Hollingworth, Dobcross, Saddleworth, Yorkshire—Construction of power looms.
306. H. F. Kemp and W. Skey, Root Distillery, Louth, Lincolnshire—An improved food for cattle.

INVENTION WITH COMPLETE SPECIFICATION FILED.

325. J. M. E. Masson, Rue des Fossés, St. Thomas Evereux, France — Apparatus to facilitate working under water.—4th February, 1859.

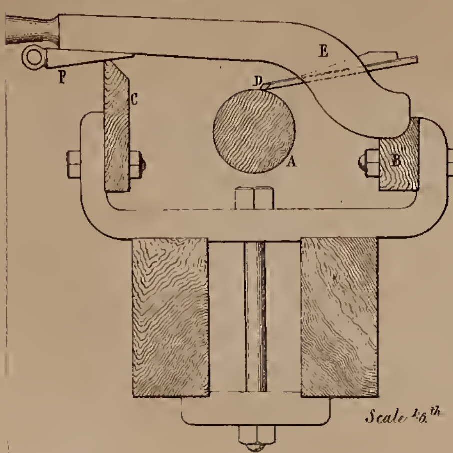
DESIGNS FOR ARTICLES OF UTILITY.

4145. January 3. A. McDougall, 17, Addle-hill, St. Paul's Churchyard. "Cart, Van, and Waggon Pulley Tail."
4146. „ 5. J. Lee, 54, Dame-street, Dublin, "The Hibernian Mantle."
4147. „ 6. P. Currie, Summer Hill Works, Birmingham, "An Improved Fastener for Sashes and other purposes."
4148. „ 6. W. Blenkiron, 23, Wood-street, Cheapside, "The Kensington Brace."


COPYING MACHINERY.
Fig 1. American Copying Lathe.
E
D
F
C
Fig 7. Lathe for Hollowing Sabots.
Plan.
C
Scale 1/8th
Fig 10
A
D
8. Machine for Cutting Gun Stocks.
E
H
F
G
Scale 1/4th.
Fig.9. Machine for making Wood Plugs of Minie bullets.
B
F
G
C
I
H
A
D
E
K
Scale 1/4th.

COPYING MACHINERY.

Fig 1. American Copying Lathe.



Scale 1/6th

Fig 7. Lathe for Hollowing Sabots. Plan.

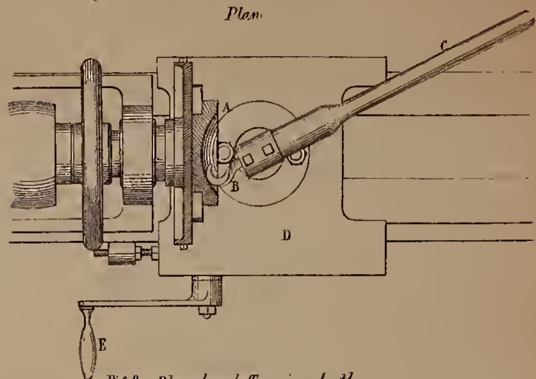
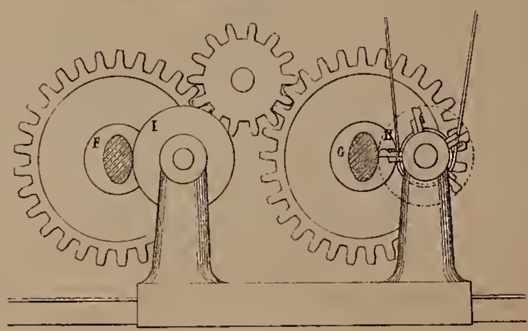
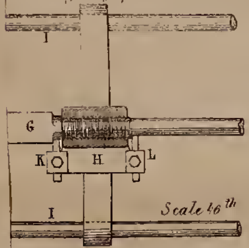


Fig 8. Blanchard Turning Lathe.



Scale 7/8th

Fig. 2. American Lathe for turning long poles.

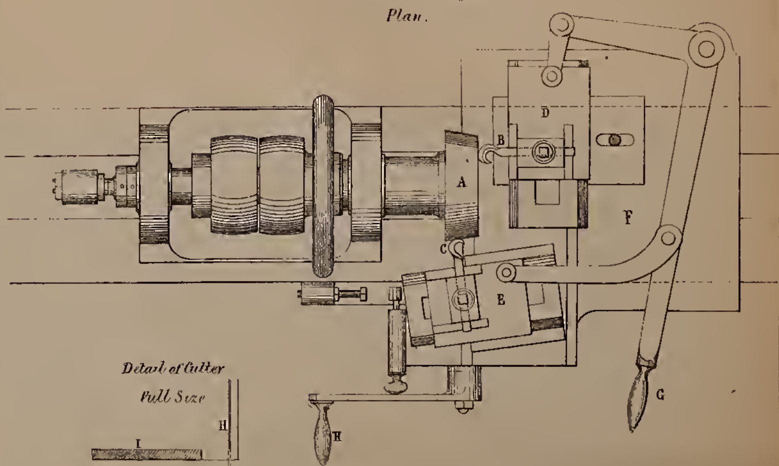


Scale 1/6th

Fig 3. Lathe Centre for turning wood.

Scale 1/3rd

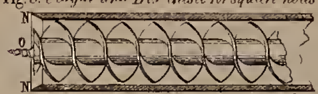
Fig 6. Lathe for Turning Sabots. Plan.



Scale 1/8th

4.

Fig 5. Augur and Box Chisel for square holes.



Scale 1/3rd

Machine for Edge Mouldings.

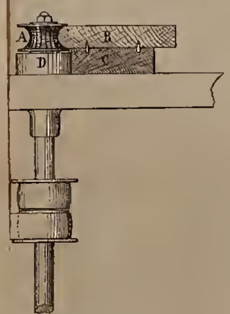
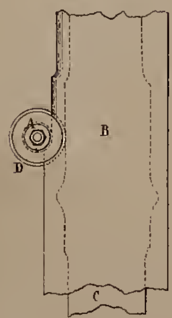
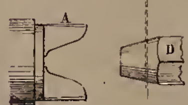


Fig 12. Plan.

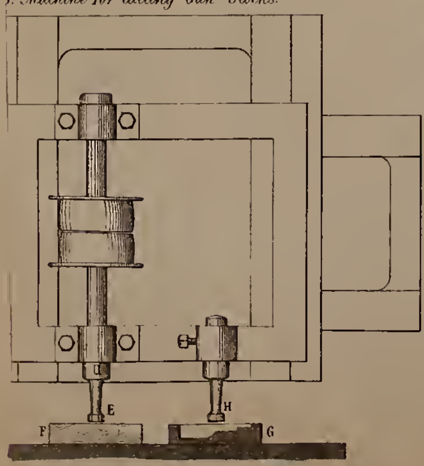


Detail of Cutter Full Size

Fig 10

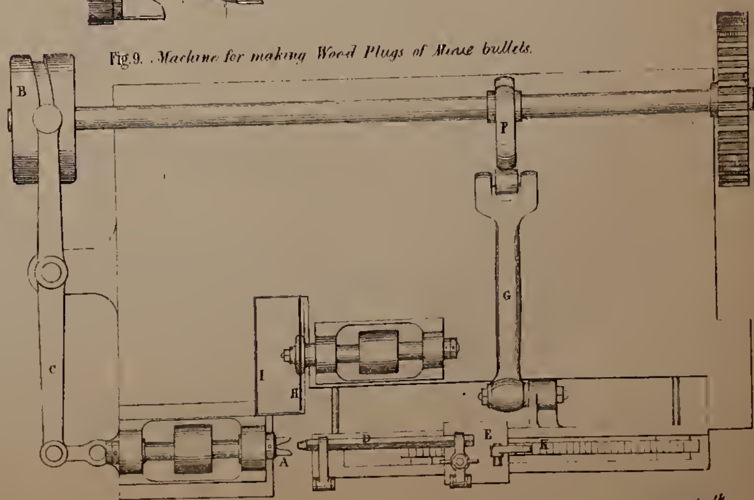


. Machine for Cutting Gun Stocks.



Scale 1/4th

Fig 9. Machine for making Wood Plugs of Minie bullets.



Scale 1/4th

SECTIONAL ELEVATION

R. ROBERTS' FLOATING LIGHTS

FIG. 2
PLAN OF FIRST DECK

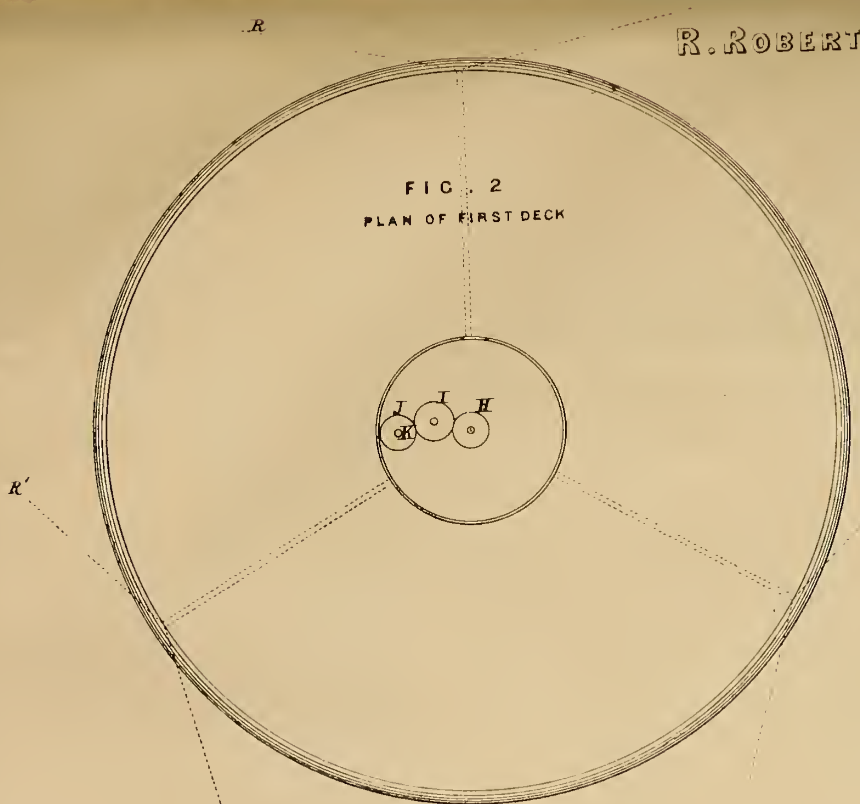


FIG. 1.

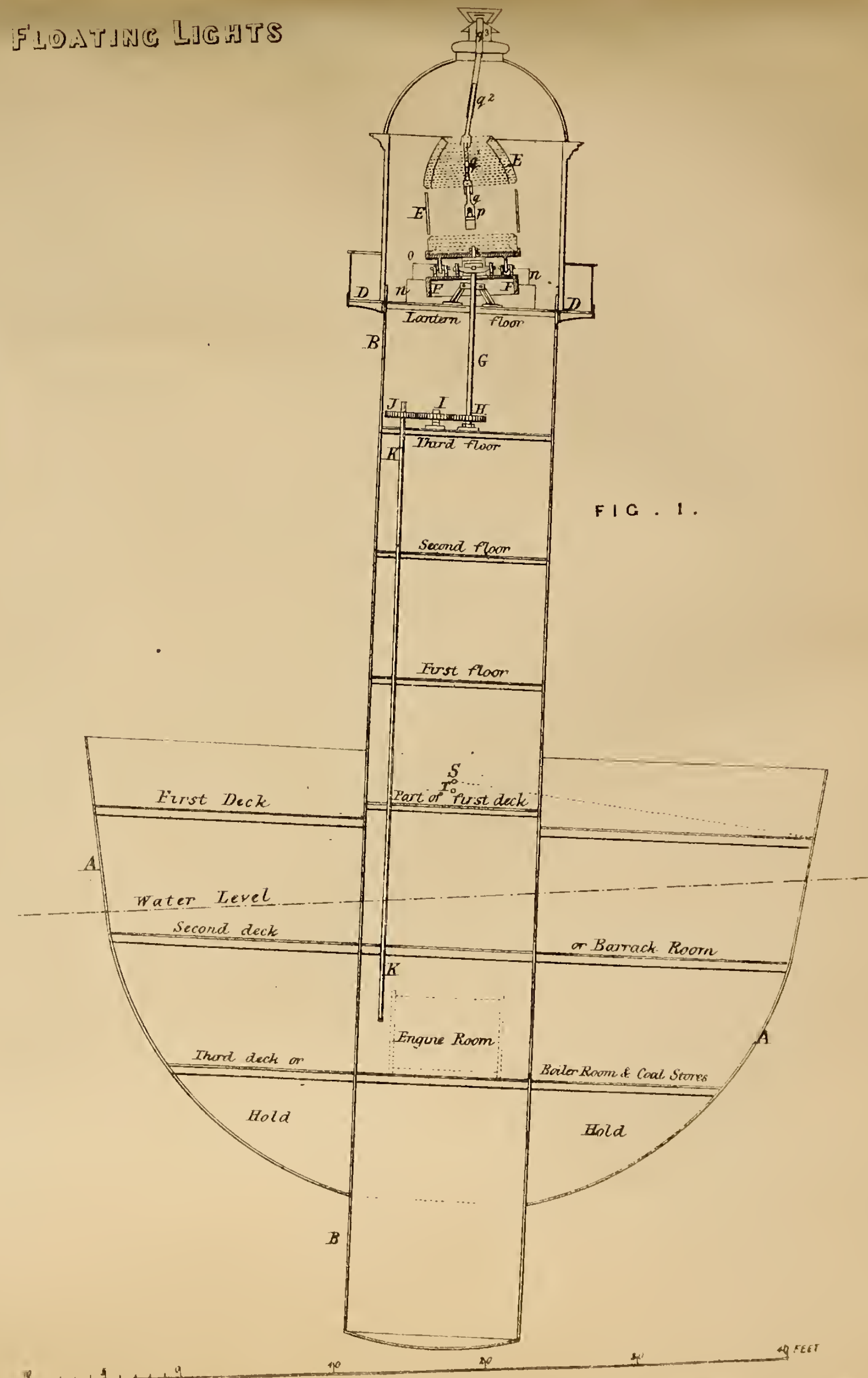
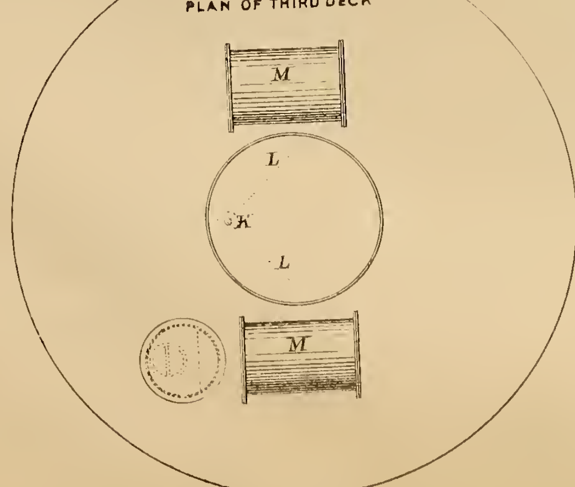


FIG. 3.
PLAN OF THIRD DECK



PLAN AND ELEVATIONS OF SHOT TOWER.

DESIGNED BY WM SMITH, C.E.

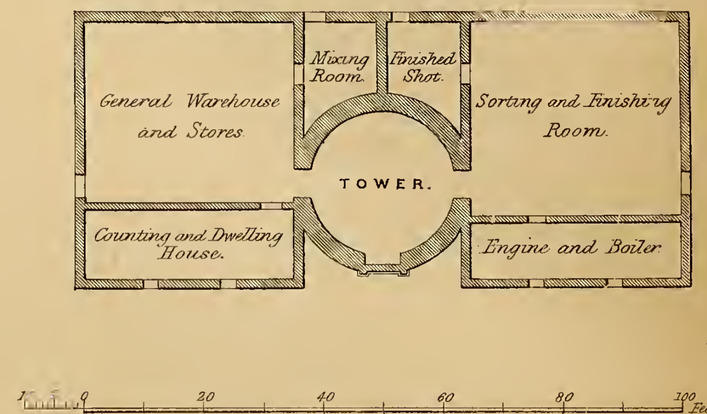


FIG. 4. GROUND PLAN.

FIG. 1. FRONT ELEVATION.

FIG. 2. SIDE ELEVATION.

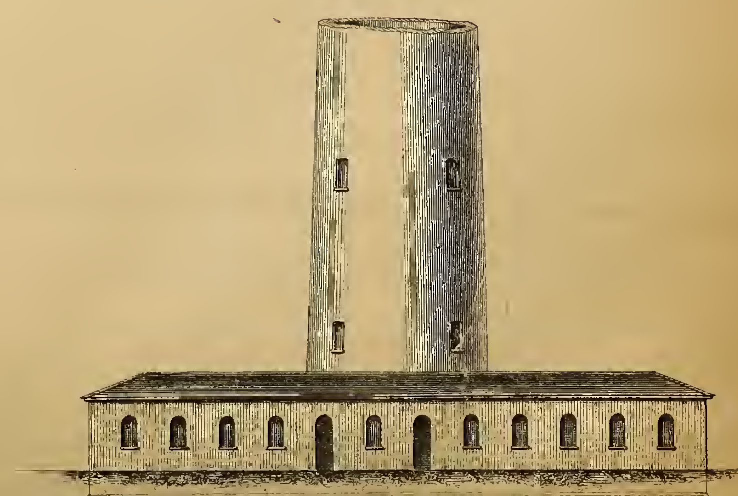


FIG. 3. BACK ELEVATION.

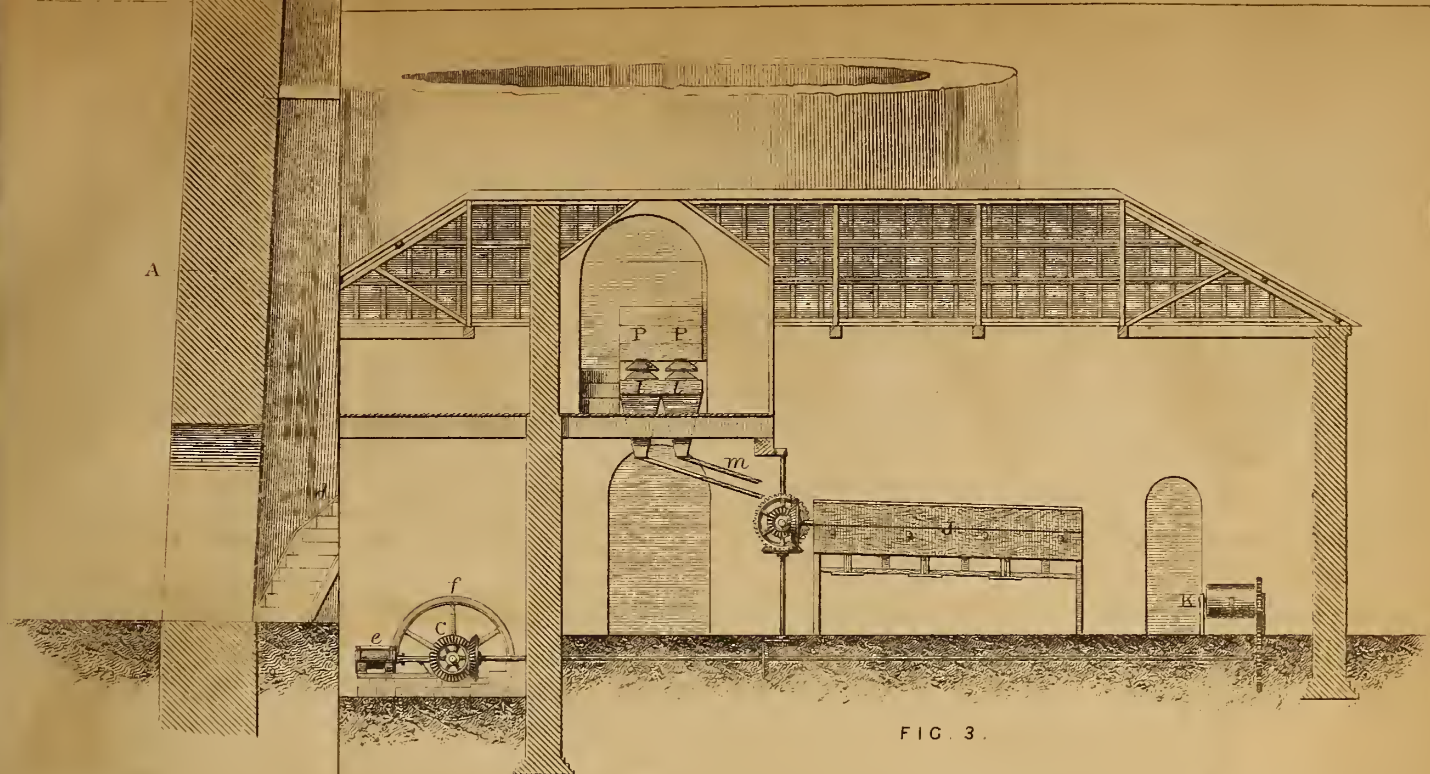


FIG. 3.

PLANS AND SECTIONS

OF SORTING AND FINISHING ROOMS &c

OF

SHOT TOWER.

DESIGNED BY Wm SMITH, C.E.

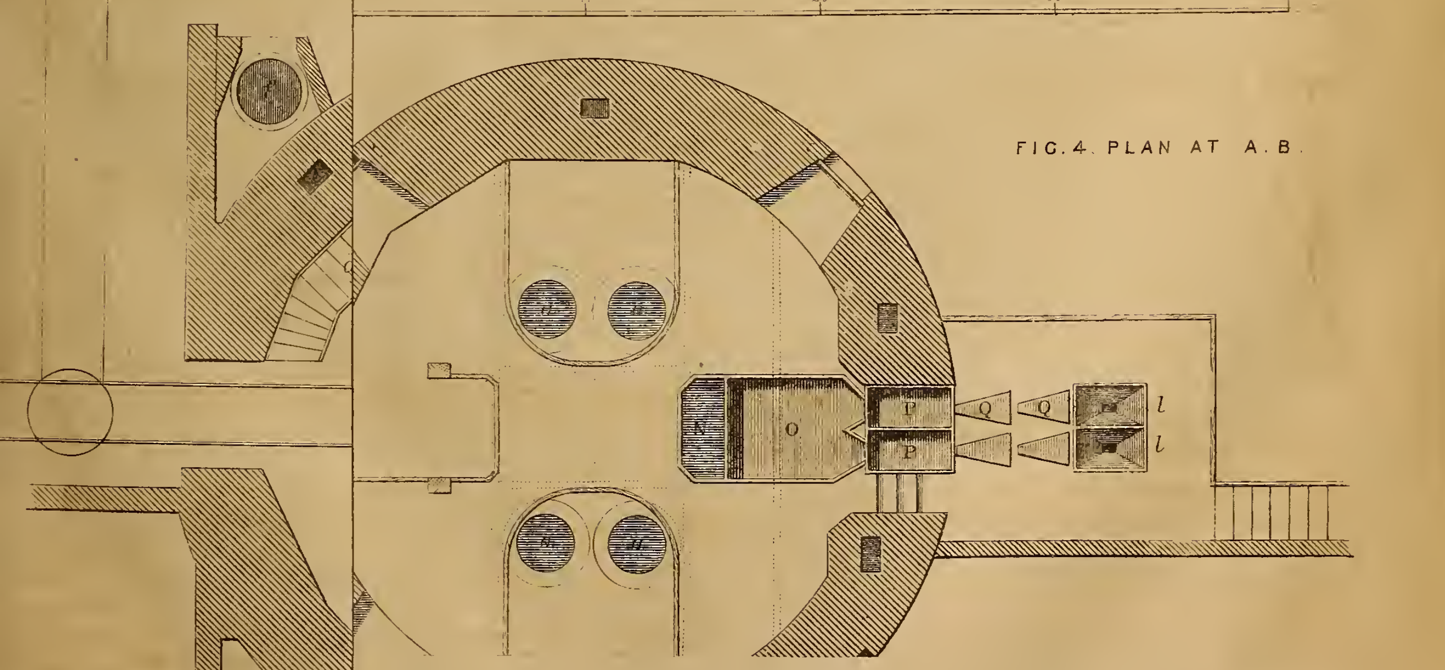


FIG. 4. PLAN AT A.B.

FIG 2

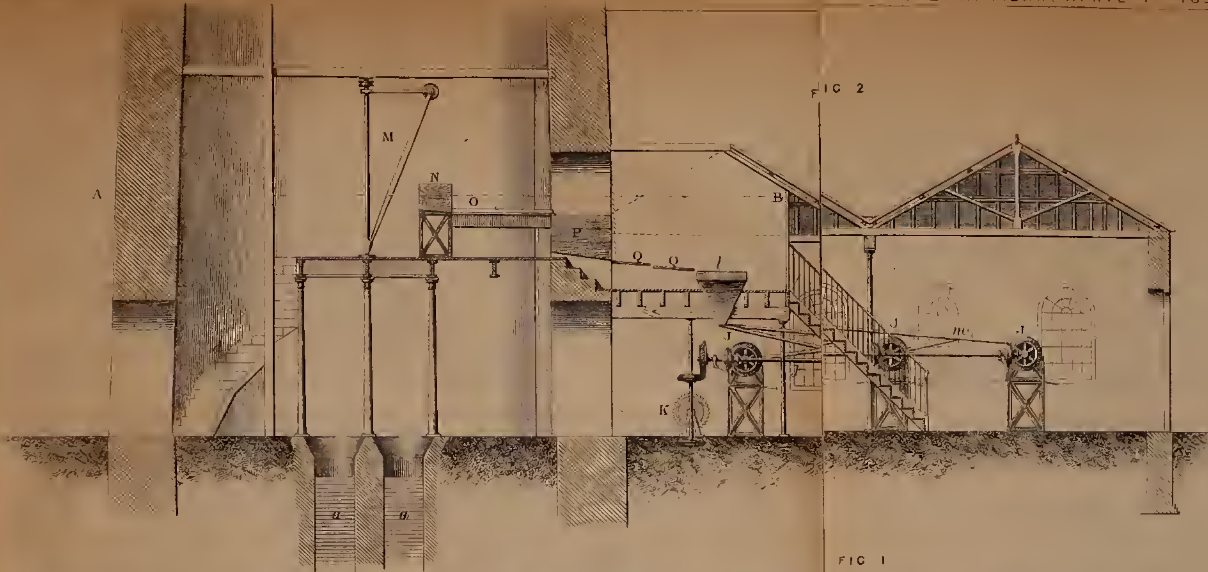
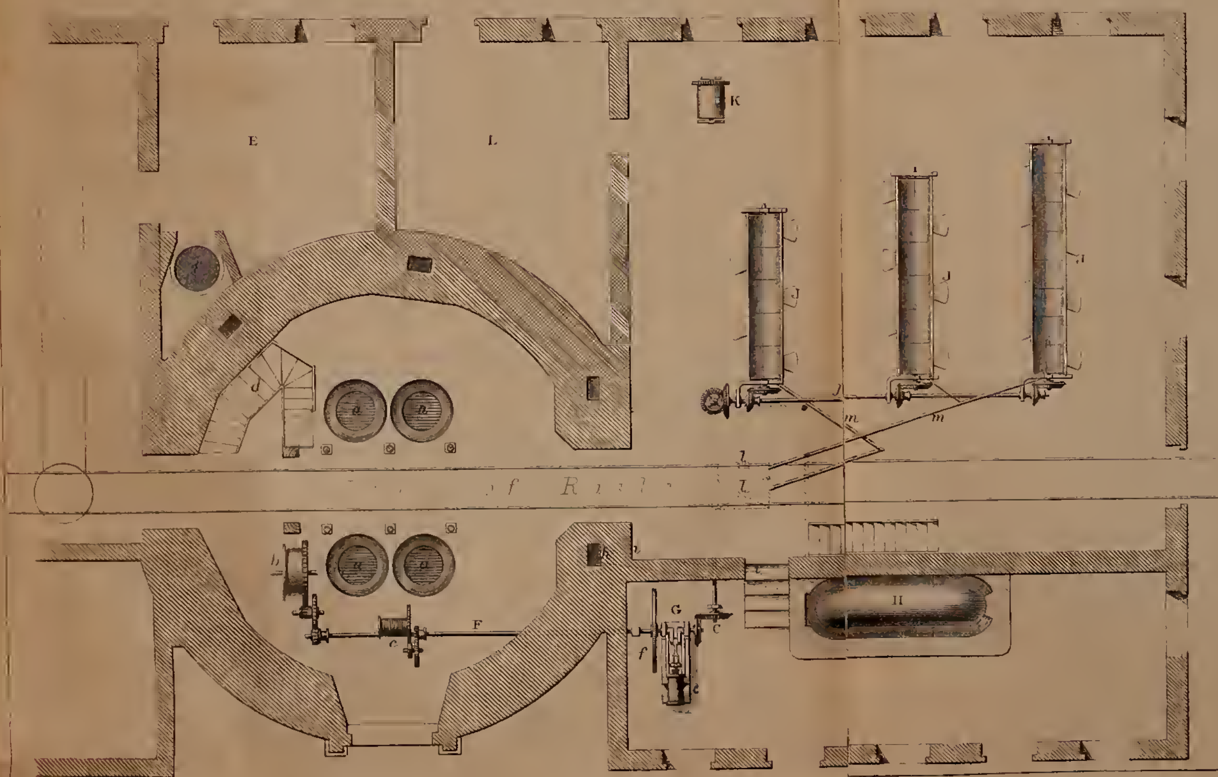


FIG 1



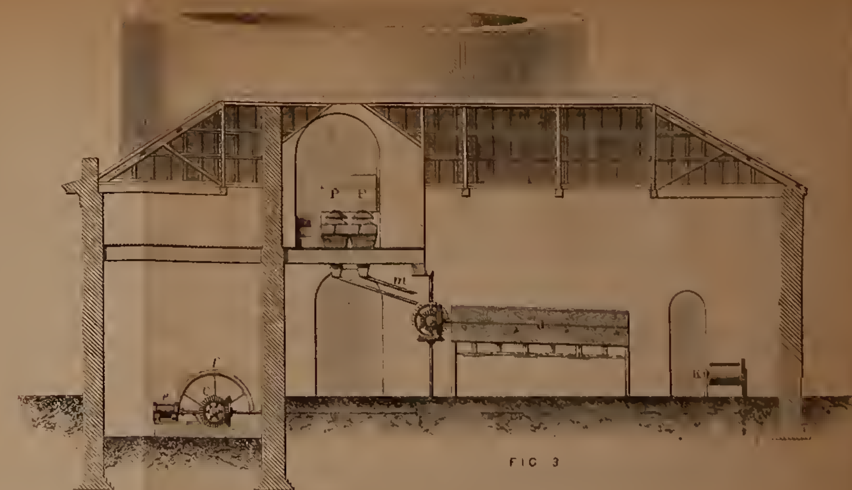


FIG 3

PLANS AND SECTIONS

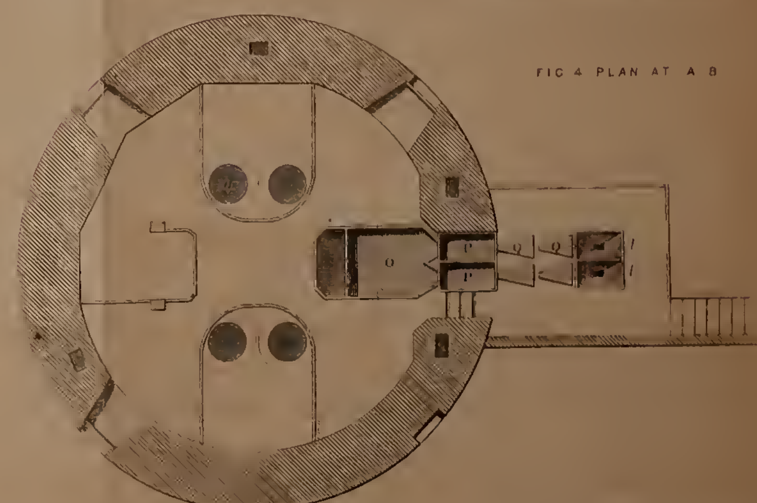
OF SORTING AND FINISHING ROOMS &c

OF

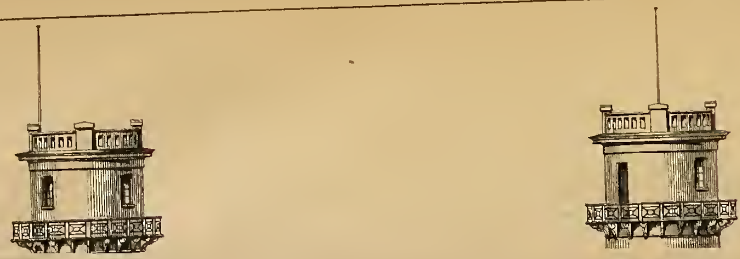
SHOT TOWER.

DESIGNED BY Wm SMITH, C E

FIG 4 PLAN AT A B



PLAN AND ELEVATIONS
OF
SHOT TOWER.



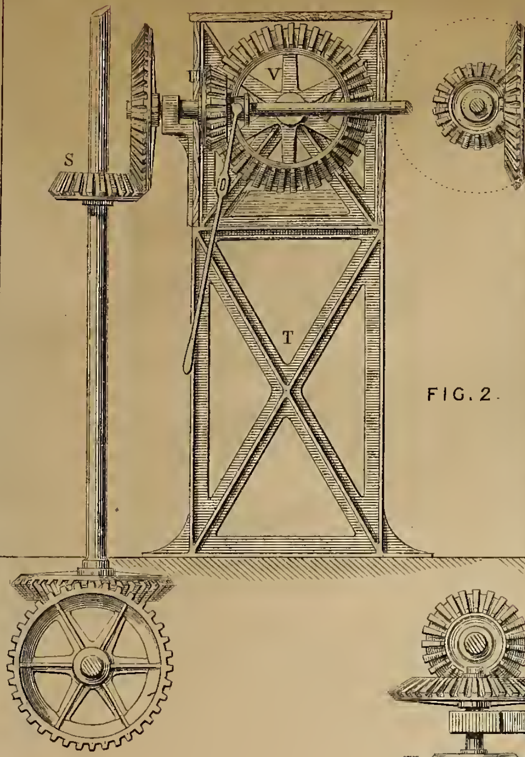


FIG. 2.

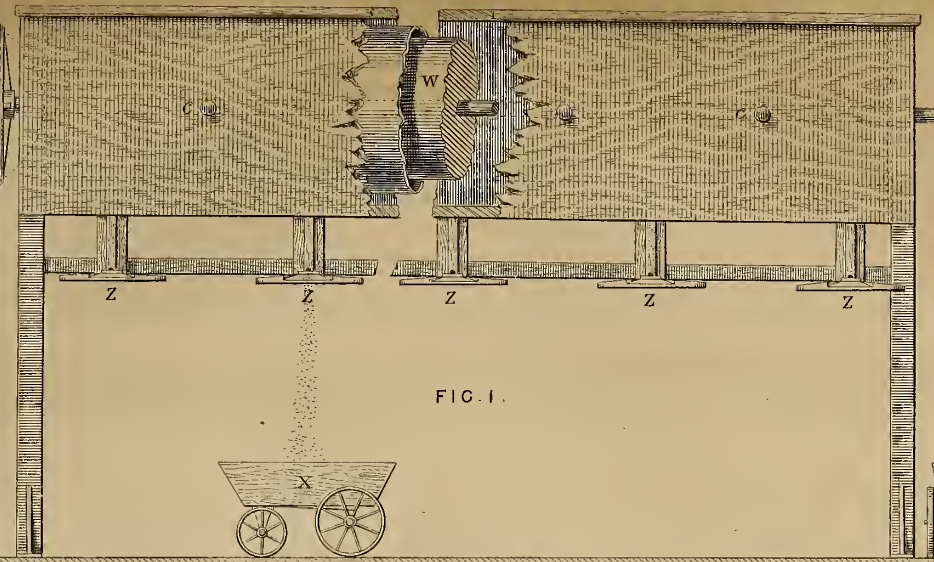


FIG. 1.

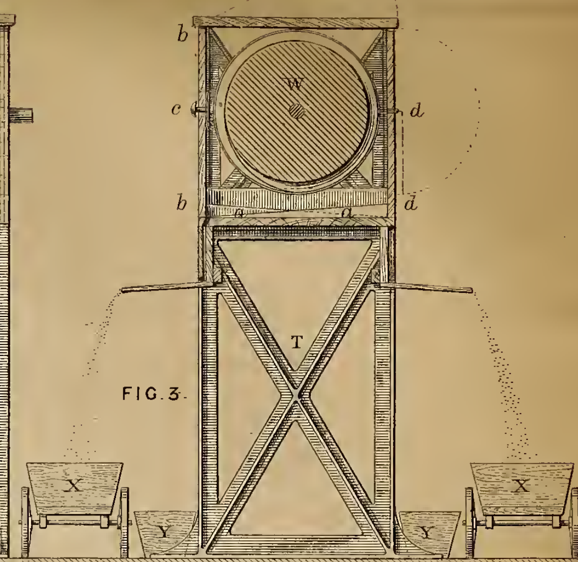


FIG. 3.

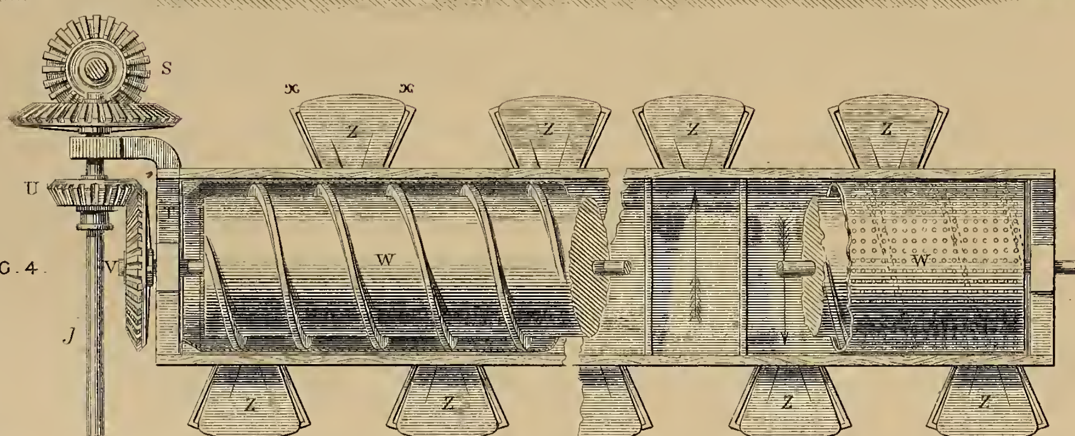
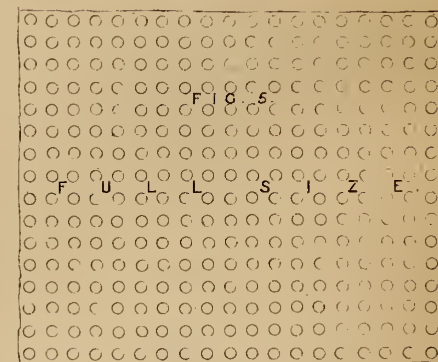


FIG. 4.



DETAILS OF SORTING MACHINERY, &c.

OF

SHOT TOWER.

DESIGNED BY Wm SMITH, C.E.

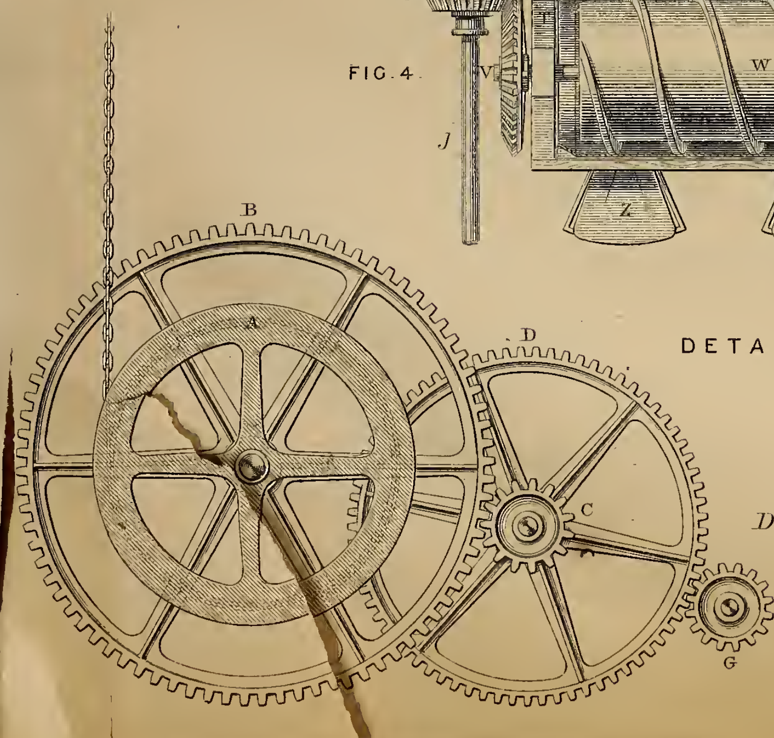


FIG. 6.

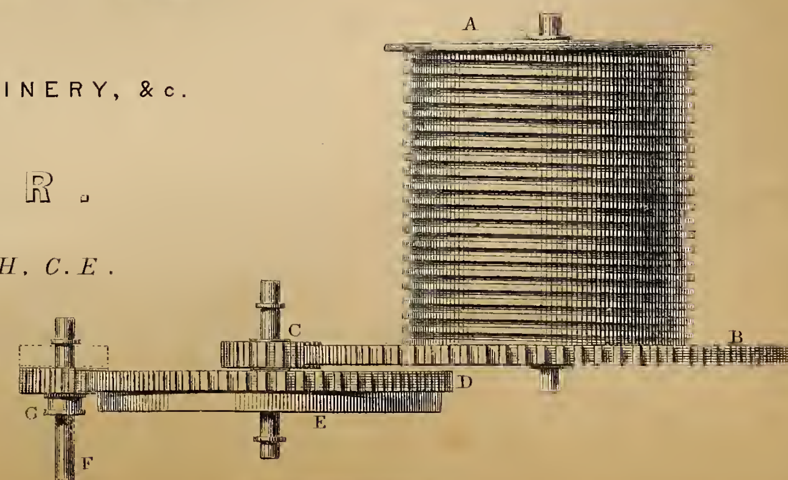


FIG. 7.

SCALE ½ IN TO A FOOT.

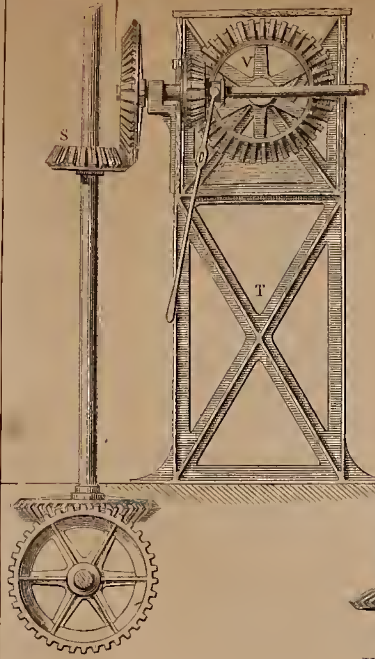


FIG. 2.

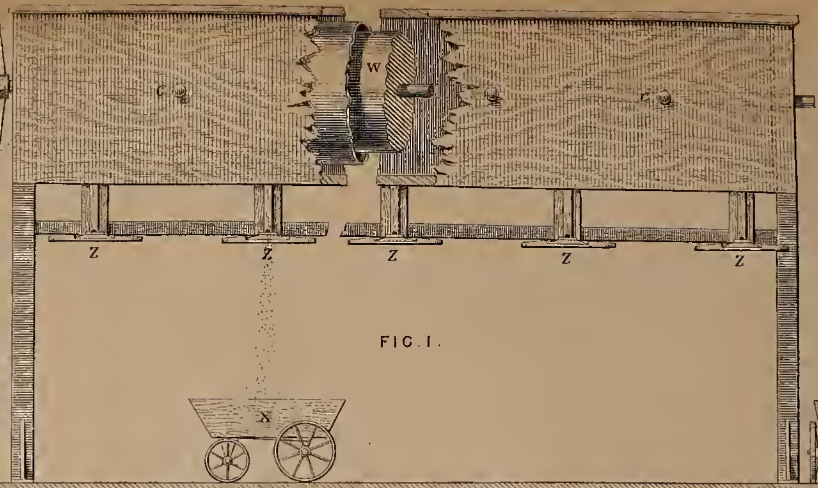


FIG. 1.

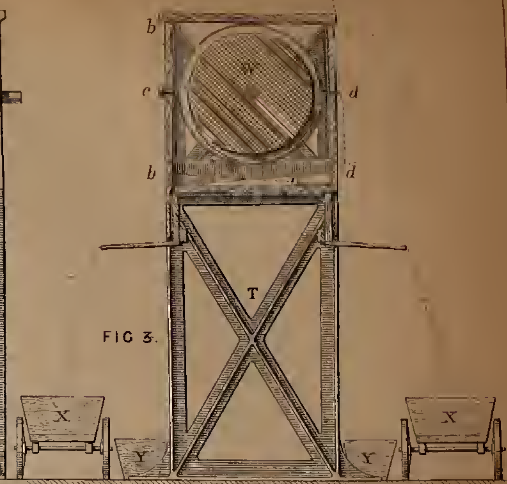


FIG. 3.

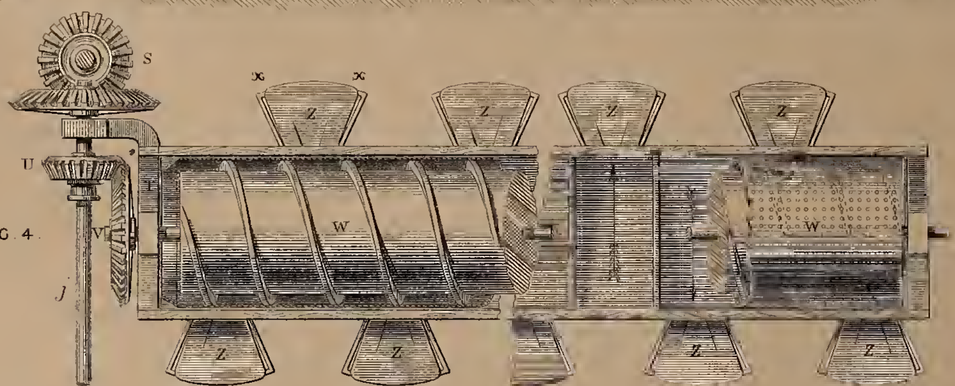


FIG. 4.

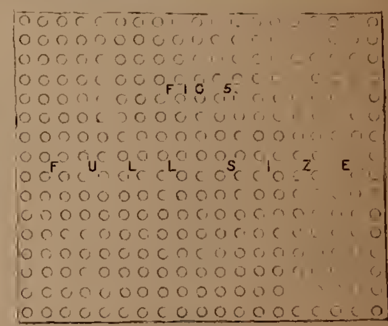


FIG. 5. FULL SIZE.

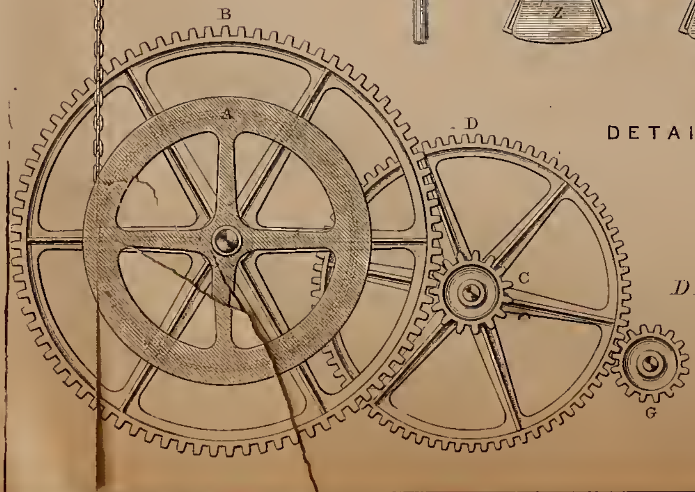


FIG. 6.

FIG. 7.

DETAILS OF SORTING MACHINERY, &c.

OF

SHOT TOWER.

DESIGNED BY Wm SMITH, C.E.

SCALE ½ IN TO A FOOT.

THE ARTIZAN.

No. 195.—Vol. 17.—APRIL 1st, 1859.

THE MANUFACTURE OF LEAD SHOT.

(Illustrated by Plate No. 141.)

In The Artizan for September last, we commenced a series of plates illustrative of the above subject; we have since, as occasion offered, and in accordance with the promise then made to our subscribers, given further views, and now give, with The Artizan for April, a large Plate (No. 141), being plans and sections of the sorting and finishing rooms and of shot tower, to an enlarged scale.

After giving the following extracts from the specification of the buildings and machinery, we shall, in a future number, proceed to describe in detail the practical operations of lead shot making; meanwhile we proceed to describe generally the arrangement of the buildings and the machinery.

In the accompanying drawings are given the scales to which the several figures relating to the buildings, &c., are drawn, affording ready means of ascertaining the dimensions of every part.

The brickwork of the buildings is drawn of a strength amply sufficient, and so proportioned as correctly to convey to the builder all particulars necessary for estimating their cost and for erecting them.

The extent of foundation shown is such as is conceived amply sufficient for supporting the superstructure, where the ground is of a gravelly character, or where only a thin layer of marly or light clay soil superimposes a gravel or stony bed. The contractor selected for executing the works should, in the absence of proper professional assistance, be chosen for his practical skill and local knowledge of the foundation he will have to erect the works upon, and he should be made responsible for the sufficiency of the foundation and the solidity of the works generally.

In Plate No. 139, for Feb. last, it will be seen—Fig. 1, a front; Fig. 2, a side; and Fig. 3, a back elevation, of the manufactory and tower; and Fig. 4, an entire plan taken on the ground line.

In Plate No. 129, Fig. 1, is an enlarged elevation, and Fig. 2 an entire section throughout, exhibiting the ground floor and the lower shot-making floor, at the height of 100 ft.; the upper shot-making floor an external cast-iron gallery; a cast-iron cistern for rain-water; a pair of guides for guiding the hoisting-box; as also a floor to which the shot are craned up and dried, shown more fully in the plans hereafter described.

The figures in Plate 129, given in The Artizan for September last, are therein generally described; but the following description of the parts taken in conjunction therewith, will make the illustrations more distinctly understood. In Figs. 3, 4, 5, 6, 7, and 8 (Plate 129), A A, are the melting pots on each floor, set in a furnace capable of melting the composition, and maintaining it at an uniform temperature. B B, the boxes with their shot "cards," through which the metal runs, and from which it falls in the shape of shot. C C, are two rings of raised railing, formed to surround and protect the circular holes or passage ways through the lower shot floor. Through these two openings, C C, the hot shot from the upper floor pass, on their way to the shot-pits (*a a a a*, Plate 141), containing water. D D, steps for enabling the shot-maker to reach and command both the fluid metal in the pots, A, and the "cards," B. E E are the guide of the hoist.

The circular water-tank within the open parapet is shown in Figs. 3 and 4.

Plate 141, Fig. 1, is a ground plan of the tower and manufactory at the ground-floor line. *a a a a*, are the pits for receiving the shot from the working floors. *b* is a chain barrel and crane machinery for lifting the shot buckets from the pits to the floor above. *c* is a barrel and machinery for raising or lifting goods to the working floors above. *d* is a staircase from the ground to the crane floor. E is a room for mixing or tempering the lead, preparatory to sending it up for running into shot. *e* is a flue for the furnace. *f* is the lead pot for melting, shut in with an iron door. F is a shaft from the steam engine to the cranes. G, a horizontal 5 H.P. steam engine. *e*, the cylinder. *f*, fly-wheel. *c*, a pair of bevel wheels for working the sorting-cylinders. H, the steam boiler, the flue from the furnace being led into the chimney flue, *h* (see dotted lines, *i i*). J J J are three screw sorting-machines, the screws being driven by the horizontal shaft, *j*, with bevel pinions and wheels, furnished with handles for throwing out of gear. The shot, when dried above, are deposited in hoppers, *l*, *l* (dotted lines), from whence they are conveyed to the screw machines by the shoots, *m m*; K is a "jem," or black-lead machine, in which the shot are polished on being taken from the screw machines, and are then stored away for delivery in the room, L.

Fig. 2 represents a section through the tower and manufactory, in which the same letters of reference denote the same parts wherever they occur. M is the crane, working on a pivot, for raising the shot. N is a hopper, into which the shot are delivered from the crane to be dried. O is a cast-iron drying table, heated either by the waste steam from the engine, by a flue running in the direction of its length, and returning to the chimney-flue; or it may be heated by the hot air and gases from the steam-engine flue, in the same manner as if by the waste steam.

At N there is a slider, regulated by a screw, for allowing the required discharge of shot to the drying table (see also the Figs. 3 and 4). P P are two hoppers, into either of which the shot are allowed to fall on being dried, according to their size, and are prevented from falling into the other by a dam put in the opening. Q Q are sloping boards, down which the shots roll on being allowed to escape from the hoppers, through an opening regulated also by a slider and hand-screw. On running down these inclined boards, the spherical shots will run in about a central direction, and fall into the hoppers, *l*, *l*, whilst those that are deformed will roll off sideways, and fall into waste boxes below, for re-melting. At the bottom of the hoppers, *l*, *l*, there are also regulating screw-sliders, for allowing the required flow of shot to the trunks or shoots, *m*, *m*, leading to the sorting cylinders.

In Fig. 2 is a transverse section of that part of the factory which is built out from the back of the tower, and into which the shots are permitted to run by gravitation, to be finally sorted, polished, and stored. The shot, after leaving the hoppers, *l*, *l*, run down the shoots provided therefrom to the rotating sieves or sorting machines, J J, which machines are worked by means of the mill gearing from the bevel wheels, C, and the polishing drum, K, is worked by a continuation of the same shaft.

Figs. 3. 4, 5, 6, 7, and 8, represent plans and sections of the two shot-making floors, where are shown the melting-pots, in every case arranged so as to enable the largest amount of work to be done. The references on these figures require but little explanation.

The "cards," or perforated plates, through which the fluid metal is run, are here shown as square boxes, supported upon open ironwork stands, which are erected over the openings left in each floor. The metal is lifted out of the melting-pot by means of a ladle, and gently poured into the box or cullender, or on to the card or sieve, the upper surface of which, or the interior of which, having first been coated or lined with a sufficient depth or thickness of scum or oxide of lead from the melting-pot. The pots hold about two tons each, the fire being applied as shown.

The description of the process of covering the cullenders or cards will hereafter be given.

Dr. Ure has described the mode of performing the processes in an order so unsuited to the economical working of the manufacture, that it would be impossible to succeed in making shot to compete with other makers at the present day if followed strictly.

In our next a Plate, giving details of the sorting cylinders and other machinery, will, if possible, be given, and the concluding illustrations, and the description of the process of melting, compounding, and pouring the metal, and making and finishing shot, will be concluded.

THE NECESSITY FOR GOVERNING MARINE ENGINES.

We have long since advocated the adoption of governors upon the engines of sea-going steamers, and advised underwriters and marine insurance companies to insist upon the application of such an instrument, or, where none is adopted, charge a higher rate of insurance; and, as a greater guarantee for safety to marine machinery, we have even suggested that coercive measures be employed when steam-ship owners would not see to their interest in making this improvement.

The great saving of fuel in rough seas is so mathematically palpable, and so well qualified by practice, that no one who has an interest in ocean steamers should hesitate a moment relative to an improvement of such vital importance.

In point of economy of power in driving steamships, there is a given or limited speed, at which the screw or paddle-wheel may be turned for best execution. This fact is of course considered in the proper construction of all steam-ships. It is important, then, as well for the benefit of the machinery, as the marking the best possible time, that an evenness of motion should be maintained, avoiding also by that means an improper application of steam. In cases of the racing of the engine in rough seas, greater exertions are ordinarily made at firing up, in order to make time; but with the use of a governor under the same circumstances, *less than ordinary firing up is required*, on account of the simple fact, that as the propeller or paddle-wheel is relieved from the water or resistance, proportionably less steam is required to drive them, the flow of the latter being regulated to correspond with the requirements of the screw or paddle-wheel under their constantly varying depths of immersion; and hence the stoek of fuel is prolonged with a rough voyage, also the neeessity, which so often happens, of putting into the nearest port for coals, very likely avoided.

Now that so reliable an instrument for the purpose is available, it is pleasing to know that the subject is receiving in some quarters sueh marked attention, it being extensively adopted in the ships sailing from the northern ports of Great Britain, from whence we have received numerous reports of the most favourable eharacter, the general sentiments of which will be found in the following from Mr. Oldham, of Hull:—

"Silver's Patent Governor having been in use several voyages between Hull and Antwerp, on board the screw steam-ship *Alster*, the property of Messrs. Gee and Co., of this place, I have very great pleasure in reporting to you the high satisfaction it has given both to Captain Maycock, the commander, as well as Mr. Rymer, the chief engineer. The perfect control it possesses over the aetion of the engines, and their beautiful regularity and uniformity of motion, even in severe gales and rough seas, imparted by its influence, inspire the greatest confidence in all on board. Frequently in stormy weather the engines could not be left for a moment, and even with strict attention there was great danger of aceident. But by the adoption of your Patent Governor, life and property have become far more secure, to say nothing of less wear and tear, and saving of fuel, which, there is no doubt, will prove to be considerable. It is in consequence of the highly satisfaetory result in the working of the apparatus of the *Alster*, that I have been directed by Joseph Gee, Esq., to order a governor for the steam-ship *Lord Cardigan*. (Signed)

"James Oldham, Civil Engineer and Inspector of Steam-ships."

The Government of the United States have included in the specifications of the late orders for new steamers, marine governors; and as a test of the best form to be applied, the Navy Department appointed a Board of Engineers to examine and report upon the most available plan. The following is a copy of their report:—

"*Philadelphia, February 14th*, 1859.

"Sir,—In obedienee to your order of January 31st, we have examined and witnessed the operation of Mr. Thomas Silver's marine governor, as applied to an engine now in operation at the United States Mint, in this city, and respectfully report that, on the occasion of our visit to the mint, the engine was employed in driving two sets of rolls for drawing silver and copper, and was consequently subjected to sudden variations of duty, ranging from 15 to 40 H.P. These sudden changes enabled us to satisfy ourselves of the action of the instrument, which we found to be so prompt and sensitive that no appreciable difference could be observed in the speed of the engine. But the great object whieh Mr. Silver had in view in devising this governor was to neutralise the action of gravity, which affects all governors when the eentre of gravity of the balls falls below the point of support. This he has accomplished, in such a manner that the point of support coincides with the centre of gravity of the balls, and the governor will therefore act promptly, no matter in what position it may be placed, and it is consequently perfectly adapted for use on board marine steamers.

"As we have not had an opportunity of witnessing the operation of a marine governor at sea, we called upon Captain West, who formerly commanded the Collins steamer *Atlantic*, on which vessel one of the governors was attached. He informed us that he considered it a most valuable appendage to a marine steam-engine, and that its operation was perfectly satisfactory under all circumstances, and more particularly while scudding, when the engines performed with great regularity, and the value of the instrument was then made plainly evident, all racing being effectually prevented.

"Mr. Silver has also exhibited a model of a governor constructed upon a different principle. In this form the inertia or regulating nature of a momentum wheel is used, by having the shaft (which turns loosely in the centre of the momentum wheel) geared in the ordinary manner to the engines, so that should the shaft be turned at a speed differing from that which the momentum wheel has attained, a differential movement is given to the sliding sleeve, as in the ordinary governor, exerting an immediate action on the throttle-valve, with a power commensurate with the sudden start of the engine. The momentum wheel is impelled in advance of the shaft by the force of a spiral spring, to a degree sufficient to hold the throttle-valve open whilst the engine is running steady; but the speed of the wheel is also limited by the vanes, which are attached to it for atmospheric resistance. These vanes can be set at any angle, to suit the desired speed; so also can the springs be compressed or liberated, which forms a second means of regulating speed. The action, as shown by the model, is very prompt and decisive, and, at the same time. extremely sensitive. This plan has been adopted, in several instances with great success, on board English screw-ships, as shown by original letters from the owners, submitted to our inspection; but it has never been applied in this country. We enclose herewith a drawing, showing both plans. As we are aequainted with but one other form of marine governor (that of Mr. John Rice), and as that has not yet had a practical test, a comparison cannot be made fairly without such test, which we regard as the only method of arriving at a correct knowledge of their relative merits. After a very careful investigation, we are of opinion that either form of this instrument, as shown in the drawing, will operate in a satisfactory manner on marine engines, and we therefore respectfully recommend it to the Department for a practical trial.

"Jno. P. Whipple, } Chief Engineers,
(Signed) "Henry H. Stewart, } U. S. N.
"Edwin Fithian, 1st Assist. Eng., U. S. N.

"To Hon. Isaac Toucey, Sec. of the Navy."

It has been argued that in cases of an engine running too fast, although the ports of the cylinder are opened just as wide in the case of racing as running at regular speed, and steam, as ordinarily used, is capable of maintaining its comparative pressure in the cylinder with that in the boiler, at a speed of about 1,000 ft. per minute, that no more steam escapes from the latter than when running at its proper velocity. The conception or theory seems to be, that steam is of a dense milk-and-water character, and is capable of passing the ports only at a given speed, but still possessing elastic qualities, so that that which is within the cylinder drives the piston when relieved from a load at an increased speed, without a more rapid augmentation from the boiler. Well, no matter how fallacious the argument, suppose we admit it then, since overrunning the screw is but loss of time to the ship,—the excess of steam which causes it, a loss of money,—and the overstraining of an engine from the violent bringing-up, the frequent cause of very heavy expenses for necessary repairs; we ask, then, why not govern the flow of steam to the legitimate demand, and avoid all the loss and destruction of property? To this query common sense can make but one reply. We have even heard it said also, that when an engine races, the rapidity with which a slide-valve moves back and forth over the ports rather saves steam than otherwise, on the supposition that the latter is prevented thereby from passing into the cylinder so freely; we trust, however, that there are but few amongst practical engineers who know so little of the nature of steam, as the above notions would indicate; but whoever they may be, if they will but notice a steam-gauge attached to the cylinder, they will find that, whilst the flow of steam is not interfered with, the pressure will be nearly maintained upon the piston, whether raeing or running at proper speed. It very necessarily follows, then, that when an engine runs at double speed that it exhausts nearly double the amount of steam from the boilers to drive it, and it is easy to see why a steam-ship should run short of fuel when without a governor in a rough voyage. We have long contended that, no matter what the state of the weather or roughness of the sea, the marine engine should develop its power in proportion to its resistance, with as uniform a motion as the engine on land which drives its rolling mills, and has been so amply proven entirely practieable on ships. In rough and partieularly short seas, to guard against dangers to the machinery, it is common to make a permanent reduction of the flow of steam to the engine; but even at that, the power is quite sufficient to cause sudden starts of the engine, that produce fractures in the machinery, which, when full power is let on, sooner or later terminates in a break.

REPAIRING DOCK GATES.

A very simple and ingenious arrangement, invented by Mr. B. Hockin, of the Gateshead Iron Works, has been successfully applied for the purpose of enabling dock gates and their machinery to be examined and repaired without interrupting the business of the dock or canal, which, it is well known, is a matter of considerable importance. The difficulty of obtaining divers who combine excellence in their own art with the necessary ability as mechanics, for executing some repairs to the machinery of some large gates, necessitated some such contrivance as that which Mr. Hockin produced and applied with entire success, and which is equally applicable for a variety of other under-water operations of a similar character. In our next we intend to give two views illustrative of the invention, which but for an accident would have been given herewith.

NEW ENGINE AT THE ROYAL MINT.

At the Royal Mint they are erecting a 40 H.P. combined high and low pressure engine, for the purpose of driving the rolling-mills. Messrs. Hall, of Dartford, are the contractors for it, their estimate having been found slightly lower than those of the Messrs. Rennie, and of James Watt and Co. The old rolliug-mill engine is one of 30 H.P., erected in 1810, by Boulton and Watt; and it has certainly done the State some service during the forty-nine years of its existence. This very creditable specimen of the early days of engineering will not be removed, but kept as a duplicate to its modern and more powerful neighbour. There can be no question that the additiou of a new steam-engine to the already extensive mechanical resources of the Mint is a step in the right direction, for almost everybody admits the necessity for "more money." It is the universal want, and the authorities at Tower-hill are evidently preparing to make the supply equal to the demand.

The foundations for the new engine are already in, and not many weeks will elapse before it will be engaged in the lamination of bars of gold and silver, and of slabs of more modest copper, for the production of current coin. It has been stated, and we believe with truth, that the cost of this very important adjunct to the money-making establishment represents a fraction only of the savings effected in the working expenditure of the Mint during the past two or three years under the judicious and careful mastership of Dr. Graham, F.R.S., &c.

fields of practical and scientific thought into which he ventured. We may say, however, that the Paper was made sufficiently interesting to evoke considerable applause, and, after some eulogistic remarks from Mr. Stapler, a vote of thanks from the large assembly who listened to it.

Mr. Newton, with much feeling, alluded to the small amount of sympathy shown by employers towards the Association, and urged those gentlemen to ascertain for themselves, by attending their meetings, the way in which the Society was conducted. So far from there being anything inimical to the interests of those with whom the members were so intimately connected, employers, if they would but honour them with their presence, would soon discover that it was just the reverse. The necessity of raising a Benevolent Fund, apart from the General Fund, was also suggested by the Chairman. The proceedings terminated with an announcement that Mr. Thyte would, on the first Saturday in April, read a Paper on The best Means of producing Heavy Iron Castings.

AMERICAN NOTES FOR 1859.—No. 3.

Herewith, in addition to the dimensions of the *Albatross* screw steamer, I send you notices of a batch of very useful inventions, which will be found as valuable amongst our friends in Europe as they have been here amongst us.

DIMENSIONS OF STEAMER "ALBATROSS."

Built by George Greenman, Mystic Bridge, Connecticut; Engines by Corliss Steam Engine Company, Providence, R.I.

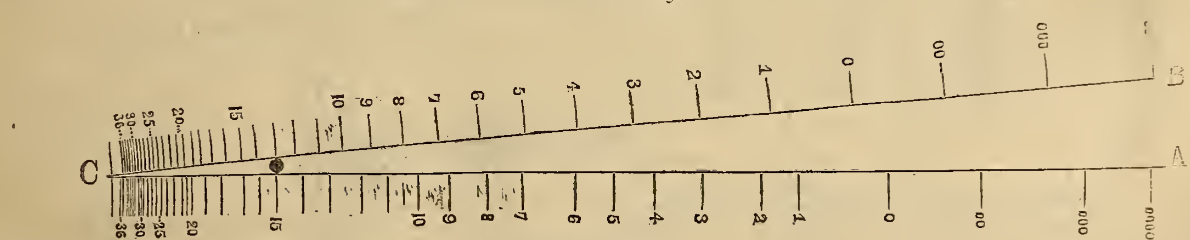
	Ft.	In.
Length on deck	158	0
Breadth of beam	30	0
Depth of hold	10	0
Depth of hold to spar deck	10	0
Hull / Engine-room	450 tons	

Kind of engine, vertical direct acting; ditto boiler, return flue; diameter of cylinders (two), 34 in.; length of stroke, 2 ft. 10 in.; diameter of screw, 10 ft. 8 in.; length of screw, 2 ft.; pitch of screw, 19 ft.; number of blades of screw, 4; number of boilers, 1; length of ditto, 24 ft.; breadth of ditto, 10 ft.; height of ditto, exclusive of steam chests, 10 ft. 8 in.; number of furnaces, 2; breadth of ditto, 4 ft. 6 in.; length of fire bars, 6 ft.; number of tubes above, 14; number of ditto below, 10; internal diameter of ditto, 12, 15, and 17 in.; length of ditto, 17 ft. 6 in. and 10 ft. 6 in.; diameter of chimney, 4 ft.; height of ditto, 20 ft. 6 in.; area of immersed section at load draft, 310 ft.; load on safety valve in lbs. per square inch, 75; date of trial, December, 1858; draft forward, 11 ft.; ditto aft, 13 ft.; average revolutions, 60; weight of boiler without water, 52,000 lbs.

Frames, 13 in. by 10 in., and 12 in. and 26 in. apart. depth of keel, $1\frac{1}{2}$ in.; independent steam, fire, and bilge pumps, 1; rig, schooner.

Intended service—New York to Providence.

New Gauge.



Old Gauge.

ALLOYING COPPER FOR COINAGE PURPOSES.

In America, we are told that they are employing nickel as an alloy with copper in the manufacture of coin, and that the mixture is good, both in appearance and for wear and tear. At home there is some idea of using aluminium for a like purpose, and there is no doubt that the tendency of all government actiou in the matter is towards a reduction in weight of the inferior coins. The bronze used in France consists of 95 parts of copper, 4 of tin, aud 1 of ziuc, and this produces a far superior metal to copper for the purposes of the coinage. The Cauadian decimal bronze coins, recently put into circulation, are of metal identical in character with the bronze used in the Napoleon five and ten centimes.

ASSOCIATION OF FOREMEN ENGINEERS.

On Saturday, the 6th ult., the ordinary meeting of the Association of Foremen Engineers took place, and Mr. Joseph Newton, of Her Majesty's Miut, occupied the chair on the occasion. Several new members having been elected and others nominated, Mr. Newton proceeded to deliver what might be termed his inaugural address. He commenced by assuring those who had placed him in the honourable position in which he then found himself, that he felt the responsibility of office to be weighty in the extreme, but that, as he had been educated in the school of practical experience and had even baffled difficulties before, so he trusted now to bear up under the ordeal prepared for him. In referring to the snbject announced for consideration that evening, namely,—The Influence of Mechanical Science and Mechanical Men on the age in which we live,—the Chairman went largely into the history of mechanical invention during the last half-century, and spoke of the innumerable purposes—warlike as well as peaceful—to which mechanism and the mechanical arts were being at this hour applied. Space forbids, however, our following the speaker through the varied

NEW STANDARD WIRE GAUGE.

By J. R. Brown and Sharpe, and adopted by brass and wire manufacturers in the United States.

WIRE GAUGES.

The want of uniformity in common wire gauges is well knowu; but if they all agreed with the published tables of sizes, there would still exist serious objections to their use, as the variation between different numbers is so irregular. This will be more clearly seen by reference to the diagram.

The two lines, A C and B C, meeting at C, represent the opening of an angular gauge. The divisions ou the line, A C, show the size of wire by the common gauge, those on the line, B C, by the new standard. Wire to be measured by such a gauge, is passed into the angular opeuing till it touches on both sides, the division at the point of contact indicating the number. Thus, No. 15 old gauge, would be No. 13 by the new. The angular principle is used in the above woodcut, as it shows the difference between the old and new standard to the best advantage; it is proposed, however, to make gauges of different forms, but all to correspoud with the sizes of the new standard.

The divisions on the line, A C, it will be observed, are very irregular, while those on B C increase by a regular geometrical progression. This principle is thought by many who are conversant with the subject, to be the true one for the construction of a gauge, and when generally adopted by the manufacturers in this country, an effort will be made to introduce it in England.

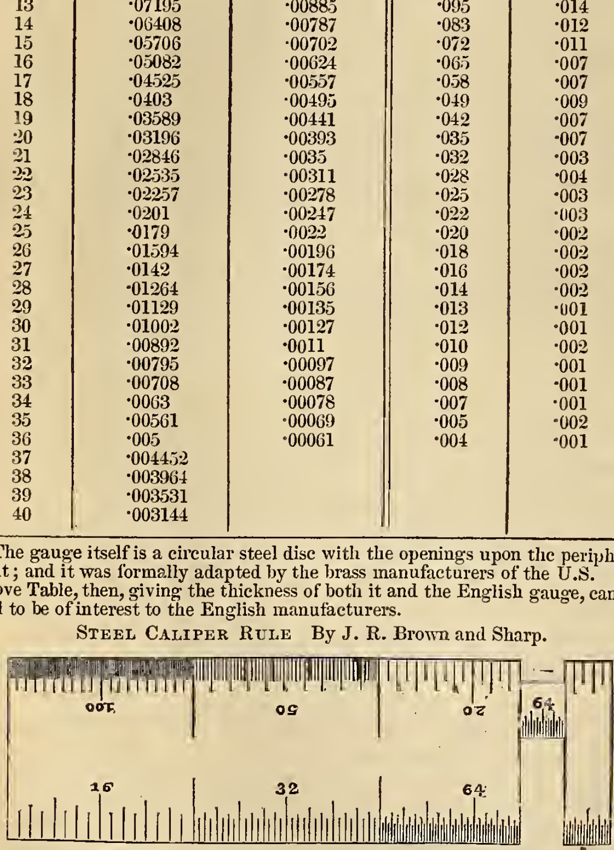
The annexed Tables show the actual dimensions of the old and new standards in decimal parts of an inch, U. S. Standard Measure, and also the difference between consecutive sizes of each gauge.

In order that the full benefit of the change may be realised, it is necessary that the gauges should be made to correspond exactly with the sizes given in the Table.

NUMBER OF GAUGE.	NEW STANDARD.		OLD STANDARD.	
	Size of each number in decimal parts of an inch.	Difference between consecutive numbers in decimal parts of an inch.	Size of each number in decimal parts of an inch.	Difference between consecutive numbers in decimal parts of an inch.
0000	·460	—	·454	—
000	·4096	·0504	·425	·029
00	·3648	·0448	·380	·045
0	·3249	·0399	·340	·040
1	·2893	·0356	·300	·040
2	·2580	·0313	·284	·016
3	·230	·028	·259	·025
4	·205	·025	·238	·021
5	·1819	·0231	·220	·018
6	·162	·0199	·203	·017
7	·1443	·0177	·180	·023
8	·1285	·0158	·165	·015
9	·1144	·0141	·148	·017
10	·1019	·0125	·134	·014
11	·09072	·01118	·120	·014
12	·0808	·00992	·109	·011
13	·07195	·00885	·095	·014
14	·06408	·00787	·083	·012
15	·05706	·00702	·072	·011
16	·05082	·00624	·065	·007
17	·04525	·00557	·058	·007
18	·0403	·00495	·049	·009
19	·03589	·00441	·042	·007
20	·03196	·00393	·035	·007
21	·02846	·0035	·032	·003
22	·02535	·00311	·028	·004
23	·02257	·00278	·025	·003
24	·0201	·00247	·022	·003
25	·0179	·0022	·020	·002
26	·01594	·00196	·018	·002
27	·0142	·00174	·016	·002
28	·01264	·00156	·014	·002
29	·01129	·00135	·013	·001
30	·01002	·00127	·012	·001
31	·00892	·0011	·010	·002
32	·00795	·00097	·009	·001
33	·00708	·00087	·008	·001
34	·0063	·00078	·007	·001
35	·00561	·00069	·005	·002
36	·005	·00061	·004	·001
37	·004452			
38	·003964			
39	·003531			
40	·003144			

The gauge itself is a circular steel disc with the openings upon the periphery of it; and it was formally adapted by the brass manufacturers of the U.S. The above Table, then, giving the thickness of both it and the English gauge, cannot fail to be of interest to the English manufacturers.

STEEL CALIPER RULE By J. R. Brown and Sharp.

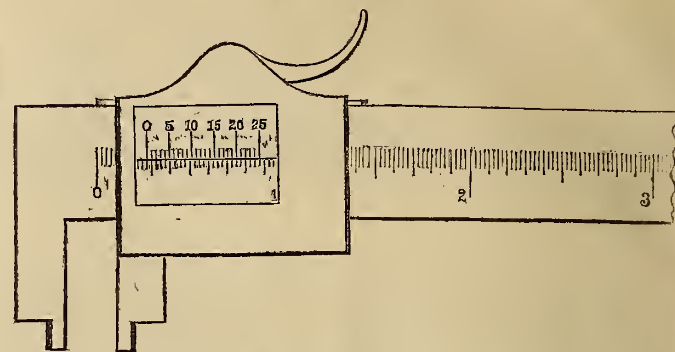


The above cut is a fac-simile of one side of these rules. The other side is divided to 24ths, 48ths, 8ths, 14ths, and 28ths on the outside, and upon the slide to 32nds and 64ths of inches. When closed they are 3 in. long. The caliper can be drawn out to measure $2\frac{1}{2}$ in. The thickness of the rule is 1-10th of an inch.

On the other side are 64ths of inches, to read without a Vernier. This instrument is furnished with both inside and outside calipers and points, to transfer the distance with dividers. It measures 7 in. An explanation of the Vernier accompanies each instrument. These instruments are made of German silver and steel. Those made of steel have the points tempered.

Description of the Vernier, and its use.—On the bar of the instrument $7\frac{1}{2}$ in. are laid down and numbered 0, 1, 2, &c., each inch being divided into ten parts, and each tenth into four parts, making forty divisions to the inch. On the sliding jaw is a line of division (called a Vernier, from the inventor's name) of twenty-five parts, numbered 0, 5, 10, 20, 25. The twenty-five parts on the Vernier correspond, in extreme length, with twenty-four parts, or twenty-four fortieths on the bar, consequently each division on the Vernier is smaller than each division on the bar by one-thousandth part of an inch. If the sliding jaw of the caliper is pushed up to the other, so that the line marked 0 on the Vernier corresponds with that marked 0 on the bar, then the two next

VERNIER CALIPER.



lines to the right will differ from each other by one-thousandth of an inch, and so the difference will continue to increase, one-thousandth of an inch for each division, till they again correspoud at the line marked twenty-five on the Vernier. To read the distance, the caliper may be open, commence by noticing how many inches, tenths, and parts of tenths, the zero point on the Vernier has been moved from the zero point on the bar. Now count, upon the Vernier, the number of divisions, until one is found which coincides with one on the bar, which will be the number of thousandths to be added to the distance read off on the bar. The best way of expressing the value of the divisions on the bar, is to call the tenths one hundred thousandths (·100), and the fourths of tenths, or fortieths, twenty-five thousandths (·025). Referring to the cut above, it will be seen that the jaw is open two-tenths and three-quarters, which is equal to two hundred and seventy-five thousandths (·275). Now suppose the Vernier was moved to the right so that the tenth division should coincide with the next one on the scale, which will make ten thousandths (·010) more to be added to two hundred seventy-five thousandths (·275), making the jaws to be open two hundred and eighty-five thousandths (·285).

In making inside measurements with the Vernier, two tenths or two hundred thousandths (·200) of an inch should be added to the apparent reading for the bigness of the caliper points. When the other side of the instrument is used, no deduction is necessary, as there are two lines of division, one for inside measurements and the other outside.

AMES' PATENT UNIVERSAL SQUARE.

Fig. 5.

Fig. 6.

Fig. 2.

Fig. 4.

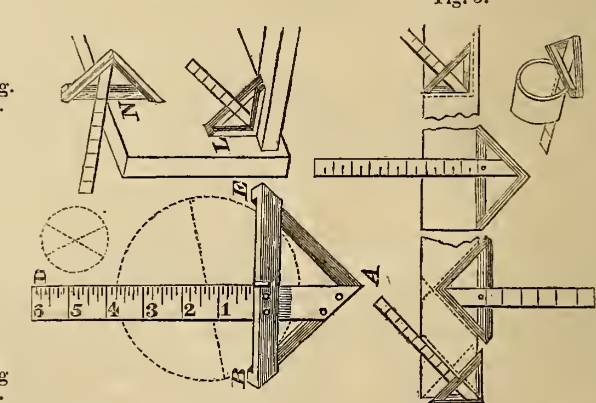


Fig 1.

Fig. 3.

The tongue, D A, Fig. 1, being fastened as it is into the triangular frame, B A E, cannot be moved or knocked from its place—in this respect constituting a great improvement over the carpenter's try-square, T-square and mitre, in common use. The instruments are made of the best material, neatly finished, and perfectly true.

Fig. 1 explains its application as a centre-square. Put the instrument over the circle, as the end of a bolt or shaft, with the arms B A, E A, resting against the circumference, in which position one edge of the rule, A D, will cross the centre. Mark a straight line in this position; apply the instrument again to another part of the circumference, and mark another line crossing the first. The point where the two lines cross each other will be the centre of the circle. The whole is the work of a moment. Fig. 2 explains the application of the instrument as a carpenter's try-square, N, and an outside-square, L; Fig. 3, as a mitre; Fig. 4, as a T-square and a graduated rule; Figs. 5 and 6, as an outside-square for drawing, and a T-square for machinists.

This square combines, in the most convenient form, *five different instruments*; viz., the try square, the mitre, the T-square, the graduated rule, and (what is entirely new) the centre-square, for finding the centre of a circle.

The *Scientific American* says of it:—

"As a centre-square alone it is invaluable to every mechanic * * * In short, it combines, in a most convenient form, so many useful instruments, no mechanic's list of tools can well be complete without a universal square."

WATCH CLOCKS.

J. R. Brown and Sharpe, also manufacture *watch clocks* for use in banks, manufactories, railroad station buildings, lumber yards, and other places where a watchman is employed, and serves to show whether he is attentive to his duty. The clock has a time dial, independent of the pin circle, which may be used as a standard time-piece for the whole establishment. From the pulls at the top of the clock, wires are led off to the different rooms in the building which the watchman is required to visit. Every half-hour the wires in *all* these rooms are required to be pulled, in order to draw back the pin, which, by the motion of the pin circle about the dial, presents itself at that time, directly over XII. Should ten minutes more than the half-hour elapse, the pin will have passed on, and cannot be drawn back, but will remain out during the succeeding day, and show the very half hour the watchman was absent or neglectful of his duty. The pins which have been drawn are replaced again by the motion of the clock. The clock should be placed in a room convenient for the exhibition of time, and care should be taken to have the termination of the wires in such places as to cause the watchman to pass over as much of the premises as possible. A good lock is provided for the case, but many prefer to have the clock placed in a room to which the watchman has no access, and furnish another time-piece to show him when to draw the pins In ordering a clock, the number of places required to be visited by the watchman every half-hour, should be stated. Full directions for putting up these clocks accompany each one. The wires can be put up by a bellhanger, or any good mechanic.

Directions for putting up the clock.—Having hung the clock by the iron plate at the top, to a firm and perpendicular wooden partition, or wall covered with wood, in order more easily to secure the case, carefully detach the pendulum, and let it hang free; when it is still, move the bottom of the clock sideways, until the screw projecting below the pendulum hangs directly in front of the notch in the brass plate, fastened to the back of the clock. This being doue, firmly secure the case, by two large screws through the holes on each side of the pendulum. Now take hold of the left hand pulley, and holding it gently down, cut the string which fastens it to the bottom of the case, and hang upon it the large weight. Pursue the same course with the other pulley and small counterweight. Finally, detach the string which is wound about the pins on the outer edge of the dial to secure them during transportation.

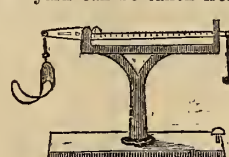
To wind the clock.—Pull down the small weight with the right hand, and at the same time gently raise the large one with the left.

To set the clock.—Take hold of the minute hand and move it either way, if the pins are not driven in; if they are, do not move to the left.

There are also other instruments made by J. R. Brown and Sharpe, of Providence, R. I., as

Yarn Assorters, for cotton or wool.—This article is now extensively used by manufacturers, and is convenient and accurate. They commence at Nos. 2, 4, or 10, as desired. The skein is put into the pan at the right (*see* Engraving), when the pointer immediately indicates the number on the graduated scale.

Yarn Reels, to accompany the Assorters.—The yarn can be taken from either bobbins or cops. The circumference of the reel is 54 in., and as the yarn is wound from seven spindles, eighty revolutions make a skein, which is indicated by a snap on the side of the worm-wheel attached.



ROVING OR YARN SCALES.

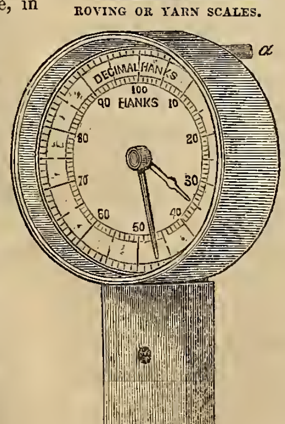
Yarn Meters.—These instruments are intended to indicate, at a glance, the quantity of yarn each spindle has been making for any given time, in hanks and decimal parts. The long hand makes one revolution to each hank; the short hand to one hundred hanks or skeins. They are usually attached to the front side of one end of the head rail of a slubber, fly frame, spinning frame, or mule, by a bolt through the hole in the lower part of the instrument. A worm is attached to the end of the front roll which gears into a wheel on the shaft, *a*, shown in the Woodcut. The number of teeth in the worm wheel is determined by the size of the front roll.

A roll $1\frac{1}{4}$ in. diameter will require a wheel of 77 teeth.

A roll $1\frac{1}{8}$ in. diameter will require a wheel of 86 teeth.

A roll 1 in. diameter will require a wheel of 96 teeth.

(Allowance should be made for twist). The wheels and worms can be made to order when the size of the front roll and the distance from its centre to the front side of the head rail is given.



YARN METER.

Roving, or Yarn Scales—By J. R. Brown and Sharpe.—These scales are intended for very delicate weighing, the tenth of a grain being easily estimated. Their general construction is so simple that the cut will show it without a description. The length of the beam is about 8 in., and the long arm, which has a small weight sliding upon it, is divided into 100 parts. These divisions indicate grains, and are numbered so as to be easily read. On the end of the long arm of the beam is a small pan, or hook, on which other weights are put when more than 100 grains are required to be weighed. The extra weights are numbered 100, 100, 300, 500, and 1,000, so that any number from 1 to 2,100 grains can be weighed.

The following will be useful to some of your Manchester subscribers:—

To Number Yarn.—If it is required to ascertain what number of yarn any machine is making, reel or measure off 9, 18, 30, 90, or any number of yards; the greater the number the more accurate the result will be. Multiply the number of yards by $8\frac{1}{3}$, and divide by the number of grains weight; the quotient will be the number of the yarn. *Example*:—Suppose 90 yards weigh 15 grains; then $90 \times 8\frac{1}{3} = \frac{750}{15} = 50$, the number of the yarn. Again: let 9 yards weigh 5 grains; then, $9 \times 8\frac{1}{3} = \frac{75}{5} = 15$, the number of hanks to the pound.

To Number the Yarn produced from Roving.—Reel or measure off a convenient number of yards of roving; multiply this number by the extent of drawing on the spinning-head. This product, multiplied by $8\frac{1}{3}$, and divided by its weight, will give the number of yarn which would be made from the roving. *Example*:—Suppose 5 yards of roving weigh 20 grains; then, 5×10 drawing $= 50 \times 8\frac{1}{3} = \frac{416{\cdot}6}{20}$ grains $= 20{\cdot}8$, the number.

To Number the Yarn produced from a given Drawing or Sliver.—Measure off a convenient number of yards of sliver; multiply this number by extent of drawing on roving and spinning heads; then multiply by $8\frac{1}{3}$, and divide by the weight, which will give the number of yarn produced from the given sliver. *Example*:—Take 2 yards of sliver, weighing 20 grains. 2×5 the draw $= 10 \times 10$ the draw $= 100 \times 8\frac{1}{3} = \frac{833{\cdot}3}{20}$ grains = No. 41·6.

To determine the number of hanks, or decimal parts of hanks, to the pound, for carding, drawing, slubbing, roving, and yarn, according to a given number of yards reeled or measured, multiply the number of yards by $8\frac{1}{3}$, and divide by their weight; the quotient will be the hanks, or decimal parts of hanks, required, corresponding to tables given in "Scott's Practical Cotton Spinner." To determine what weight a given length of drawing, slubbing, roving, and yarn, should be, to equal given number of hanks, or decimal parts of hanks, required, multiply the given number of yards in length, by $8\frac{1}{3}$, and divide by number of hanks, or decimal parts of hanks, required; the quotient will be the weight of the given length of drawing, &c., corresponding to tables given in "Scott's Practical Cotton Spinner."

To find the Number of Yards of Cloth to the Pound.—Cut from the cloth a piece 2 in. square. The weight of this, multiplied by half the width of the cloth, gives a product which, divided into 389, equals the number of yards to the pound. *Example*:—Suppose we have a piece of cloth 27 in. wide, from which a piece 2 in. square is cut, weighing 20 grains. $\frac{27}{2}$ wide $= 13{\cdot}5 \times 20$ grains $= \frac{389}{270}$ grains $= 1{\cdot}44$ yards to the pound. Another, $\frac{30}{2}$ wide $= 15 \times 10$ grains $= \frac{389}{150}$ grains $= 2{\cdot}52$ yards to the pound.

Table for Numbering Yarn by Grains,—Troy Weight.

No. Gr.	No. Gr.	No. Gr.	No. Gr.	No. Gr.
5—1400	29—241·5	52—134·7	75—93·3	98—71·4
6—1166·6	30—233·4	53—132·1	76—92·1	99—70·7
7—1000	31—225·8	54—129·7	77—90·9	100—70·
8—875·	32—218·8	55—127·3	78—89·7	105—66·7
9—777·8	33—212·2	56—125·	79—88·6	110—63·6
10—700·	34—206·	57—122·8	80—87·5	115—60·9
11—636·4	35—200	58—120·7	81—86·4	120—58·3
12—583·3	36—194·6	59—118·6	82—85·4	125—56·
13—538·5	37—189·3	60—116·7	83—84·3	130—53·8
14—500·	38—184·3	61—114·8	84—83·3	135—51·8
15—466·8	39—179·6	62—112·9	85—82·4	140—50·
16—437·5	40—175	63—111·1	86—81·4	145—48·3
17—411·9	41—170·8	64—109·3	87—80·4	150—46·7
18—389·	42—166·7	65—107·7	88—79·5	155—45·2
19—368·5	43—162·8	66—106·1	89—78·6	160—43·8
20—350·	44—159·2	67—104·4	90—77·8	165—42·4
21—333·3	45—155·6	68—102·9	91—76·9	170—41·2
22—318·3	46—152·2	69—101·4	92—76·1	175—40·
23—304·5	47—148·9	70—100·	93—75·3	180—38·9
24—291·8	48—145·8	71—98·6	94—74·5	185—37·8
25—280·	49—142·8	72—97·2	95—73·7	190—36·8
26—269·3	50—140·	73—95·9	96—72·9	195—35·9
27—259·3	51—137·3	74—94·6	97—72·3	200—35·
28—250·				

SHIPBUILDING ON THE CLYDE.

We have not for a considerable time past been able to afford space for many of the Ship-Building statistics which have from time to time been forwarded to us; but we now avail ourselves of the first opportunity of publishing a list of vessels which have been built at Greenock during the years 1857 and 1858, which will be continued from time to time, and when taken in conjunction with the lists already published by us of the vessels in the same port up to 1856, they will form a complete record of this branch of industry at Greenock.

THE AUXILIARY IRON SCREW STEAM-SHIP "SCOTIA."

Built by Messrs. Robert Steele and Co.; machinery by Messrs. M'Nabb and Clark, for the East India and China trades.

Dimensions.	Ft. tenths.
Length	241 2
Breadth	32 4
Depth	20 6
Tonnage.	**Tons.**
Hull (Customs)	$1109\frac{68}{100}$
Poop	$86\frac{37}{100}$
Total	$1196\frac{05}{100}$
Contents of engine-room	$175\frac{16}{100}$
Register	$1020\frac{29}{100}$
Total (old measurement)	$1197\frac{29}{94}$

Port of Greenock.—Launched April 10th, 1857.

THE TIMBER PADDLE-WHEEL STEAM-VESSEL "OYAPOCK."

Built by Messrs. Robert Steele and Co.; machinery by Messrs. Caird and Co.

Dimensions.	Ft. tenths.
Length	240 2
Breadth	31 5
Depth	22 0
Tonnage.	**Tons.**
Total (Customs)	$1081\frac{82}{100}$
Contents of engine-room	$400\frac{27}{100}$
Register	$681\frac{55}{100}$
Total (old measurement)	$1118\frac{89}{94}$

Port of Rio de Janiero.—Launched June 6, 1857.

THE IRON AUXILIARY SCREW STEAM-SHIP "UNITED KINGDOM."

Built by Messrs. Robert Steele and Co.; machinery by M'Nabb and Clark.

Dimensions.	Ft. tenths.
Length	245 0
Breadth	32 0
Depth	21 9
Tonnage.	**Tons.**
Hull (Customs)	$1130\frac{83}{100}$
Poop	$124\frac{56}{100}$
Total	$1255\frac{39}{100}$
Engine-room	$188\frac{16}{100}$
Register	$1067\frac{23}{100}$
Total (old measurement)	$1229\frac{93}{94}$

Engaged in the transport service. Intended for Glasgow and Montreal trade (Anchor line). Launched June 17, 1857. Owners, Messrs. Handyside and Henderson.

THE TIMBER PADDLE-WHEEL STEAM-VESSEL "CRUZEIRO-DO-SUL."

Built by Messrs. Robert Steele and Co.; machinery by Messrs. Caird and Co.

Dimensions.	Ft. tenths.
Length	240 3
Breadth	31 3
Depth	22 0
Tonnage.	**Tons.**
Total (Customs)	$1075\frac{34}{100}$
Engine-room	$397\frac{88}{100}$
Register	$677\frac{46}{100}$
Total (old measurement)	$1118\frac{24}{94}$

Port of Rio de Janeiro.—Launched July 21, 1857. Consort to the *Oyapock*. Oscillating engines, feathering wheels, &c.

THE IRON CLIPPER SAILING-SHIP "CITY OF CANTON."

Built by Messrs. Robert Steele and Co.

Dimensions.	Ft. tenths.
Length	197 4
Breadth	31 2
Depth	20 8
Tonnage.	**Tons.**
Hull (Customs)	$853\frac{30}{100}$
Poop	$55\frac{39}{100}$
Register	$908\frac{69}{100}$
Total (old measurement)	$881\frac{34}{94}$

Port of Glasgow.—Launched August 7, 1857. Owners, Messrs. George Smith and Sons. For their Glasgow and Calcutta monthly line of packet ships. Commander, Mr. Alexander Blair.

THE IRON SCREW STEAM-VESSEL "PALESTINE."

Built by Messrs. Robert Steele and Co.; machinery by Messrs. M'Nabb and Clark.

Dimensions.	Ft. tenths.
Length	250 2
Breadth	34 2
Depth	24 3
Tonnage.	**Tons.**
Hull (Customs)	$1362\frac{78}{100}$
Houses (on deck)	$14\frac{34}{100}$
Total	$1377\frac{12}{100}$
Engine-room	$440\frac{68}{100}$
Register	$936\frac{44}{100}$
Total (old measurement)	$1381\frac{6}{94}$

Port of Glasgow.—Launched April 17, 1858. Liverpool and Egypt, &c. Owners, Messrs. James and George Burns.

THE TIMBER SAILING-SHIP "VIRGINIAN."

Built by Messrs. Robert Steele and Co.

Dimensions.	Ft. tenths.
Length	148 4
Breadth	27 8
Depth	18 4
Tonnage,	**Tons.**
Hull	$473\frac{2}{100}$
Brake	$25\frac{7}{100}$
Register	$498\frac{9}{100}$
Tonnage (old measurement)	$516\frac{85}{94}$

Port of Glasgow.—Launched January 19, 1858. For the Mauritius and Glasgow trade. Owners, Messrs. James Richardson and Co.

THE TIMBER SAILING-SHIP "ELLEN RODGER."

Built by Messrs. Robert Steele and Co.

Dimensions.	Ft. tenths.
Length	155 8
Breadth	29 4
Depth	19 5
Tonnage.	**Tons.**
Hull	$554\frac{93}{100}$
Break	$29\frac{90}{100}$
Register	$584\frac{83}{100}$
Tonnage (old measurement)	$616\frac{85}{100}$

Port of Glasgow.—Owners, Messrs. Alexander Rodger and Co. For the Glasgow and China trade. Launched June 29, 1858.

THE TIMBER SAILING-SHIP "CUBAN."

Built by Messrs. John Scott and Sons.

Dimensions.	Ft. ins.
Length	130 6
Breadth	28 3½
Depth	18 6½

$483\frac{32}{94}$ tons.

Port of Greenock.—Launched December 31, 1855. West India trade. Owner, John Kerr, Esq.

THE GLASGOW, WATERFORD, AND CORK STEAM-PACKET COMPANY'S IRON SCREW STEAMER "KILLARNEY."

Built by Messrs. John Scott and Sons; machinery by Messrs. Scott, Sinclair, and Co.

Dimensions.	Ft. tenths.
Length	148 5
Breadth	21 9
Depth	11 4½
Length of engine-room	34 6
Tonnage.	**Tons.**
Total	$281\frac{16}{100}$
Engine-room	$89\frac{97}{100}$
Register	$191\frac{19}{100}$

Port of Glasgow.—Launched July 14, 1856.

IRON SCREW STEAMER "RAITH."

Built by Messrs. John Scott and Sons; machinery by Messrs. Scott, Sinclair, and Co.

Dimensions.	Ft. tenths.
Length	72 8
Breadth	15 2
Depth	7 5
Tonnage.	**Tons.**
Total	$52\frac{9}{100}$
Engine-room	$16\frac{34}{100}$
Register	$35\frac{55}{100}$
Total (old measurement)	$75\frac{93}{94}$

Port of Kirkcaldy.—Launched October 31, 1856.

THE SAILING SLOOP "SUNBEAM" (of Greenock.)

Built by Messrs. John Scott and Sons.

Dimensions.	Ft. tenths
Length	63 9
Breadth	17 8
Depth	6 9
Tonnage.	**Tons.**
Customs	$46\frac{64}{100}$
Old measurement	$88\frac{22}{94}$

Launched November 17, 1856, for the river and coasting trades.

THE SAILING SCHOONER "ACORN" (of Greenock).

Built by Messrs. John Scott and Sons.

Dimensions.	Ft. tenths.
Length	63 6
Breadth	18 4
Depth	7 8
Tonnage.	**Tons.**
Customs	$55\frac{90}{100}$
Old measurement	$93\frac{8}{94}$

Launched January, 1857, for the river and coasting trades.

THE IRON SCREW COASTING STEAMER, "LEWIS CASTLE."

Built by Messrs. John Scott and Sons; machinery by Messrs. Scott, Sinclair and Co.

Dimensions.	Ft. tenths.
Length	81 4
Breadth	15 3
Depth	7 6
Tonnage.	**Tons.**
Total	$62\frac{33}{100}$
Engine-room	$19\frac{95}{100}$
Register	$42\frac{38}{100}$

Port of Greenock.—Launched January 12, 1857.

IRON SCREW STEAMER "BLACK BOY."

Built by Messrs. John Scott and Sons; machinery by Messrs. Scott, Sinclair, and Co.

Dimensions.	Ft. tenths.
Length	81 5
Breadth	15 0
Depth	7 9½
Tonnage.	**Tons.**
Total	$66\frac{29}{100}$
Engine-room	$21\frac{21}{100}$
Register	$45\frac{8}{100}$

Port of London. Hounslow Powder Company.—Launched July 10, 1857.

THE SAILING SHIP "CANADIAN."

Built by Messrs. John Scott and Sons.

Dimensions.	Ft. tenths.
Length	166 6
Breadth	31 6
Depth	19 9
Tonnage.	**Tons.**
Hull	$673\frac{74}{100}$
Houses on deck	$31\frac{0}{100}$
Register	$704\frac{74}{100}$
Ditto old measurement	$773\frac{69}{94}$

Port of Greenock.—Launched Sept. 5, 1857.

THE BARQUE "MANTANZAS" (of Glasgow).

Built by Messrs. John Scott and Sons.

Dimensions.	Ft. tenths.
Length	125 7
Breadth	24 0
Depth	15 9
Tonnage.	**Tons.**
Hull	$305\frac{89}{100}$
Break	$19\frac{21}{100}$
Register	$325\frac{10}{100}$
Ditto, old measurement	$333\frac{43}{94}$

THE YACHT "HEBRIDES."

Built by Messrs. John Scott and Sons.

Dimensions.	Ft. tenths.
Length	55 5
Breadth	12 4
Depth	7 6
Tonnage.	Tons.
Register	$22\frac{3}{100}$

Port of Greenock.—Timber-built. Launched June 15, 1858.

THE BARQUE "ISABELLA RIDLEY."

Built by Messrs. John Scott and Sons.

Dimensions.	Ft. tenths.
Length	105 6
Breadth	24 $3\frac{1}{2}$
Depth	14 5
Tonnage.	Tons.
Hull	$225\frac{70}{100}$
Break	$7\frac{24}{100}$
Register	$232\frac{94}{100}$
Ditto (old measurement)	$285\frac{61}{94}$

Port of Liverpool.—Launched August 24, 1858.

THE SHIP "RALSTON."

Built by Messrs. James M'Millan and Son.

Dimensions.	Ft. tenths.
Length	152 2
Breadth	28 8
Depth	18 $6\frac{1}{2}$
Tonnage.	Tons.
Hull	$531\frac{61}{100}$
Break and house	$46\frac{66}{100}$
Register	$578\frac{27}{100}$
Ditto (old measurement)	$620\frac{1}{94}$

Port of Greenock.—East India trade, &c. Owners, Messrs. Arthur, Binnie, and Co., merchants. Two decks, with poop and house on deck; square sterned; full male figure-head; classed ten years A1. Commander Mr. Thomas Toogood. Launched February 12, 1857.

THE SHIP "MARGARET SMITH."

Built by Messrs. James M'Millan and Son.

Dimensions.	Ft. tenths.
Length	158 7
Breadth	29 8
Depth	19 3
Tonnage.	Tons.
Hull	$600\frac{96}{100}$
Houses	$33\frac{19}{100}$
Register	$634\frac{15}{100}$
Ditto (old measurement)	$649\frac{41}{94}$

Port of Greenock.—West India trade, &c. Owner, John Kerr, Esq. Two decks; square sterned; full female figure-head; classed ten years, A 1. Launched September 3, 1857. Commander, R. Main.

THE CAMPBELTOWN AND GLASGOW STEAM-PACKET COMPANY'S IRON PADDLE-WHEEL STEAMER "DRUID."

Built by Messrs. Barclay, Curle, and Co., Glasgow; machinery by Messrs. Anthony and John Inglis.

Dimensions.	Ft. tenths.
Length	160 1
Breadth	20 6
Depth	9 7
Tonnage.	Tons.
Hull	$212\frac{32}{100}$
Break	$17\frac{5}{100}$
Total	$229\frac{37}{100}$
Engine-room	$104\frac{33}{100}$
Register	$125\frac{4}{100}$

Port of Campbeltown.—Diagonal trunk engines, they are placed one forward, the other aft; no figure-head, bowsprit, or galleries; two (pole) masts; schooner-rigged. Launched April 27, 1857. Commander, Mr. John Kerr.

THE IRON CLIPPER SAILING-SHIP "CITY OF PEKIN."

Built by Messrs. Barclay, Curle, and Co.

Dimensions.	Ft. tenths.
Length	196 9
Breadth	31 1
Depth	20 $8\frac{1}{2}$
Tonnage.	Tons.
Hull	$839\frac{81}{100}$
Poop	$53\frac{58}{100}$
Register	$893\frac{39}{100}$

Port of Glasgow.—Owners, Messrs. Geo. Smith and Sons, merchants. To form one of the Glasgow and Calcutta Monthly Line of Packets belonging to the same firm. Launched January 15, 1858.

THE AUXILIARY SCREW STEAM-VESSEL "TORO."

Built and fitted with machinery by Messrs. Barclay, Curle, and Co.; Glasgow, 1858.

Dimensions.	Ft. tenths
Length	131 2
Breadth	20 6
Depth	10 0
Tonnage.	Tons
Hull	$160\frac{83}{100}$
Poop	$25\frac{0}{100}$
Total	$185\frac{83}{100}$
Engine-room	$96\frac{02}{100}$
Register	$89\frac{81}{100}$
Total (old measurement)	263

Fitted with a pair of inverted cylinder-engines of 40 H.P. (nominal), diameter of cylinders, 26 in.; length of stroke, 2 ft.; diameter of screw, 7 ft. 6 in.; pitch, 16 ft. Griffith's patent, two blades, has two flue-boilers with four furnaces fixed forward: there is a tunnel at the side of the vessel, communicating with the engine-room. On the trial trip, April 2nd, the draft of water forward was 8 ft. 5 in.; aft. 9 ft. 1 in.; the engines made 84 revolutions per minute, and the speed against wind and tide was 9 knots an hour, and has been satisfactory to the owners. Is timber built, and seems to be well adapted for the purpose intended, viz., the West India cattle trade.

Port of Barbadoes.—Brig rigged, a quadruped figure-head (Bull.) No galleries: square-sterned and carnil built.

"OYAPOCK" AND "CRUZERO-DO-SUL."

Machinery by Messrs. Caird and Co.; Greenock, 1857.

Fitted with a pair of oscillating engines of 380 H.P. (nominal). Diameter of cylinders, 70 in.; length of stroke, 6 ft.; feathering paddle-wheels, diameter, 26 ft.,—the paddle boards are 12 in number; length, 10 ft.; breadth, 3 ft. 9 in. Has four tubular boilers: length, 10 ft. $8\frac{1}{2}$ in.; breadth, 12 ft.; depth, 12 ft. 8 in. There are twelve furnaces; length, 6 ft. 6 in.; breadth, 3 ft. 4 in.—924 tubes, diameter, $3\frac{1}{2}$ in.; length, 7 ft. The chimneys are 4 ft. 9 in. in diameter, and 28 ft. 6 in. in length. Heating surface, 6,900 square ft.: weight of engines, 181 tons 12 cwt.; ditto of boilers with water, 149 tons 8 cwt; draft of water at launching, 6 ft. 6 in. even keel. On the trial trip, August 15th, 1857, both vessels, having stores and 400 tons of coals on board, the draft of water forward was 11 ft. 4 in.; abaft, 12 ft. 3 in.; load on safety valve 20 lbs. of steam; engines, averaging 24 revolutions per minute; the speed being 14 knots per hour.

THE GLASGOW, WATERFORD, AND CORK SCREW STEAM SHIPPING COMPANY'S IRON STEAM-VESSEL "KILLARNEY."

Built by Messrs. John Scott and Sons, Greenock, 1856. Machinery by Messrs. Scott, Sinclair, and Co., 1856.

[Act, 1855.]	Ft. tenths.
Length	148 5
Breadth	21 9
Depth	11 $4\frac{1}{2}$
Length of engine-room	34 6
Tonnage.	Tons.
Total	$281\frac{16}{100}$
Engine-room	$89\frac{97}{100}$
Register	$191\frac{19}{100}$
Tonnage (Builders' or Old).	
Total	$346\frac{83}{94}$
Engine-room	$56\frac{38}{94}$
Register	$290\frac{45}{94}$

Fitted with a pair of inverted cylinder (trunk) engines, of 56 nominal H.P.; diameter of cylinders, 32 in. × 2 ft 2 in. length of stroke; diameter of trunks, 16 in.; the screw is three-bladed, and the diameter is 8 ft. 4 in. × 16 ft. pitch; two air-pumps, worked by beams from the trunks, having vibrating columns; one tubular boiler; three furnaces — length, 7 ft.; breadth, 3 ft.; dry bottoms; 112 tubes—diameter, 3 in.; length, 7 ft.; averages 70 revolutions per minute, with 15 lbs. steam-pressure. Carries 19 cabin and 53 deck passengers; total, 72 in winter and 89 in summer, being 70 deck and 19 cabin (Board of Trade Act). Average passages:—Greenock to Cork (423 miles), 40 hours; Cork to Waterford (90 miles), 9 hours. Launched July 14th.

DESCRIPTION.

A bust female figure-head; round sterned and clinch-built; two masts; schooner-rigged; $1\frac{1}{4}$ decks. Port of Glasgow.

Commander, Mr. John M'Donald.

THE LIMERICK AND LONDON SCREW STEAM-SHIP COMPANY'S IRON STEAM-VESSEL "MANGERTON."

Built by Messrs. Robert Steele and Co., Greenock, 1855. Machinery by Messrs. Randolph, Elder and Co., Glasgow.

[Customs Act, 1855.]	Ft. tenths.
Length	203 2
Breadth	25 7
Depth	16 1
Length of engine space	32 6
Tonnage.	Tons.
Hull	$502\frac{90}{100}$
Quarter-deck and house amidships for crew	$31\frac{84}{100}$
Total	$534\frac{74}{100}$
Engine-room	$171\frac{12}{100}$
Register	$363\frac{62}{100}$
[Builders' or Customs Act.]	
Total	$659\frac{61}{94}$
Engine-room	$114\frac{75}{94}$
Register	$544\frac{80}{94}$

Fitted with a pair of geared beam-engines, of 116 nominal H.P.; diameter of cylinders, $43\frac{1}{2}$ in. × 3 ft. length of stroke; the screw has two blades, and 9 ft. in diameter, averages 50 revolutions per minute, with 15 lbs. of steam-pressure; consuming 16 cwt. of coals per hour; average draft of water, 10 ft. forward × 14 ft. aft. The passage between the ports of London and Limerick (747 miles) is usually accomplished in 70 hours, or at the rate of 16·5 miles per hour. Official number, 5,847.

DESCRIPTION.

A demi-female figure-head; round-sterned and clinch-built; $1\frac{1}{4}$ decks; 3 masts; schooner-rigged.

Port of Limerick—Commander, Mr. Boucbier.

THE DUBLIN AND GLASGOW STEAM SHIPPING COMPANY'S IRON PADDLE-WHEEL STEAM VESSEL "HAVELOCK."

Built and fitted with machinery by Messrs. James and George Thomson, Glasgow, 1858.

[Customs Act, 1855.]

	Feet. tenths.
Length	223 2
Breadth	26 2
Depth	14 $3\frac{1}{2}$
Length of engine-room	53 7
Tonnage.	Tons.
Hull	$588\frac{29}{100}$
House (aft for cabin saloon)	$40\frac{65}{100}$
Total	$628\frac{94}{100}$
Engine-room	$289\frac{68}{100}$
Register	$339\frac{26}{100}$
[Builders' or Old Customs Act.]	
Total	$757\frac{57}{94}$
Engine-room	$311\frac{4}{94}$
Register	$446\frac{53}{94}$

Fitted with a pair of sway beam-engines, of 288 nominal H.P.; diameter of cylinders, 62 in. × 5 ft. length of stroke. Feathering wheels, diameter, 24 ft.; fourteen paddle-boards, length 8 ft. 3 in. × 3 ft. 4 in. in breadth; two tubular boilers; twelve furnaces, fired fore and aft; steam-pressure, 14 lbs. per square inch; averages $24\frac{1}{2}$ revolutions per minute; consumes 27 cwt. of coals per hour; bunkers hold 80 tons; capable of carrying 330 tons dead-weight of cargo; accommodation for 94 cabin passengers and about 500 deck ditto; average passages for two months between Greenock and Dublin (202 miles), 14 hours, equal to 14·6 miles per hour; the quickest being 12 hours and 59 minutes. This company being highly satisfied with the performances of the *Herald* (with the feathering wheel, after seven years' experience) had the *Havelock* fitted similar in all respects, only being larger, having the superiority of the feathering wheel over the common. Official number of vessel, 21,188.

DESCRIPTION.

Port of Dublin—Demi male figure-head; square-sterned and clinch-built; three masts; schooner-rigged; one and 'tween decks, with house aft for cabins.

Commander, Mr. William Stokes, late of the *Herald.*

This is the seventh vessel belonging to this Company; the others were named respectively the *Arab, Mercury, Eagle, Vanguard, Ariel,* and *Herald.*

ON SOME APPLICATIONS OF THE COPYING OR TRANSFER PRINCIPLE IN THE PRODUCTION OF WOODEN ARTICLES.

By John Anderson, Esq., Inspector of Machinery to the War Department.

(Illustrated by Plate No. 142.)

A distinguishing characteristic of the arts and manufactures of the present century as compared with those of the past consists in the application of the principle of machine copying, in contradistinction to dependence on the skill of the operative, in the production both of the ordinary articles of commerce and of the munitions of war. Engineers are so familiar with this principle in their every-day pursuits, that it frequently escapes their notice; yet a closer inspection will show that almost all machines that are intended to change the form of materials are constructed on some modification of this principle, of having the form some way or other contained in the apparatus, with the specific object of imparting that form to the materials under operation; and it will generally be found that every process which is done well, and which at the same time is done cheaply, is performed by some skilfully-arranged development of this principle. The advantage of keeping first principles steadily in view in practical applications of science is generally conceded: the knowledge of facts is considered good; but to know the law of the facts is considered better, and much more likely to hasten onwards their more extended application. A complete exposition of the various applications of this copying principle in the several arts and manufactures of the world would form a highly interesting and valuable volume.

Within the last few years a remarkable change has taken place in this respect. With regard to the tools of the smithery, production by the hammer and hand of the smith is fast giving place to production by means of apparatus constructed upon the copying or transfer principle; such as dies under the American drop-hammer, the steam-hammer, and the forging machine, the employment of rolls containing on their surfaces the pattern of what is wanted; and the use of oscillating dies imparting the form to the red-hot mass upon a moving table. In each case it is seen that the general tendency is to obtain the form and dimensions of the article produced by the transfer of both from an apparatus prepared with care, and to dispense with that care in the future actual production. The moulding operations of the foundry are pre-eminently copying; or, if it is attempted to analyse the recent improvements in the moulding of wheels, shells, railway-chairs, and such articles, it will be found that all are designed with a view to have the accuracy and perfection of form provided in the apparatus, from which it is then transferred to the sand without so much skill being required on the part of the workman who performs the ramming of the mould. The other workshops of the engineer present that invaluable development of the copying principle termed the slide-rest, assuming every variety and modification in the several machines used for turning, boring, drilling, planing, or shaping. The same principle in combination with circular cutters affords the machinery of the Small Arm Factory, the endless variety of which would alone form an interesting subject.

The object of the present paper is to give a description of a few applications of the copying principle in the production of certain articles, mostly in connexion with the simple operations of wood-turning, which have been more immediately brought under the notice of the writer; and although they are trifles in themselves, still it is only by each one making a small contribution from time to time that the improvements in the details of the several workshops can be made generally known to one another.

During a short professional tour in the United States in 1854, the writer was much struck with the many simple and ingenious contrivances there introduced, in order to apply the copying principle in connexion with ordinary hand-lathe operations, where generally in this country more would be depcudent upon the skill or attention of the turner or upon special machinery. For example, in the production of articles where there is repetition and which are to be turned in a common lathe, the application of certain very simple additions tends greatly to facilitate the operation, and to enable the operator to dispense with the usual measuring and gauging and the use of the callipers, which generally occupies so much time.

A simple arrangement of a copying lathe is shown in Fig. 1, Plate 142. At the front of the lathe and parallel with the piece of wood, A, to be operated upon, there is fixed a straight edge, B, made of hard wood, with the upper or straight edge slightly hollowed. At the back of the lathe there is a similar fixture, C, only the upper edge is not straight, but resembles the irregular form of the required article. The gouge or turning instrument, D, instead of being held in the hand of the turner over a rest, is fixed into a piece of wood, E, the arrangement slightly resembling that of a carpenter's plane, having one end adapted to slide firmly on the straight edge, B, at the front of the lathe, while the other is adapted to trace the irregular line, C, running along the back. In order that the workman may gradually reduce the wood to the proper diameter, without the risk of digging into the mass and thereby breaking the cutting instrument, a small wedge of wood, F, is attached by a loop to the little finger of his right hand, and at the commencement of the operation is inserted between the toolholder E and the irregular pattern, C, at the back of the lathe, but is gradually withdrawn as the article approaches the required diameter; and at the last a finishing tool is slowly and carefully drawn along the two guides, B and C, thus producing the exact pattern without any effort, and in much less than half the time in which it could be done in the common way.

On a similar plan to the foregoing, but differently arranged, is the American system of turning long poles of small diameter, as shown in Fig. 2, Plate 142. The wood, G, to be turned is first cut by a circular saw into square rods of the required length; these are then placed between the centres of a turning lathe, with the corners still upon them. The toolholder or cutting apparatus, H, slides steadily upon two parallel straight edges, I I, placed respectively at the front and back of the lathe. This toolholder consists of a metal socket, H, having cutting gouges, K and L, at each end. The foremost gouge, K, is set to reduce the square rod to the internal diameter of the socket, H, in order to obtain perfect steadiness; while the second or finishing gouge, L, is set to reduce the pole to the required diameter. To relieve the workman from the trouble of pushing the socket, H, with its cutting tools along the lathe, the interior of the socket is made with a screwed surface; and the first gouge, K, being set to give a tight fit, the thread which is thus formed upon the wood draws the socket along; and as the second gouge, L, is close to the hinder end of the socket, the thread does not make its appearance, being cut off by the second gouge, which is set to give the proper finished diameter to the work. In turning long small poles of an irregular figure, the second tool, L, is not a fixture upon the socket, but is held in a toolholder having one end hinged upon the socket, while the other traces the required pattern placed alongside, thus causing the tool to rise or fall as it slides along the pattern.

It may be mentioned that the American wood-turners use a centre which is not common in this country; and having been introduced into the Royal Arsenal with great advantage, its general application can be recommended. This lathe-centre, which is shown in Fig. 3, Plate 142, instead of having the ordinary sharp point, is formed at the extremity with a hollow cup, M, surrounded by a sharp circular edge; this, when pressed into the revolving wood, forms a hard centre within itself, by compression of the wood within the conical cup, which is better adapted both to retain the oil and also to continue uninjured during a long period.

The method of turning the sabots or blocks of wood which are attached to round shell, as performed in the arsenal at Woolwich, affords another illustration of the successful application of the copying principle. Hitherto these articles have been produced by the wood-turner with the gouge, chisel, and gauges, in the usual manner; it was a monotonous and very laborious process, and a skilled workman could produce only about fifty of them per day.

By the new method, the wood is first cut out of the plank into circular pieces by means of an ordinary trepanning tool, costing for wages an average of 7d. per hundred. The wooden disc is then perforated by a drilling machine, in order to prepare it for being screwed upon the face-plate of a turning lathe.

The first turning process is to form the exterior surfaces, and for that purpose the wood is screwed upon the centre screw of the face-plate, as shown at A, Fig. 6, Plate 142. The tools or gouges, B and C, that are required to produce the form, are contained on separate sliding-rests, D and E, combined together upon one saddle, F, both being actuated by the movement of a single handle, G. The saddle, F, itself is made to slide upon the lathe-bed in the ordinary manner, by means of a rack and pinion, and is moved by the left hand of the workman, by means of the handle, H. The dimensions of the sabot are determined by a stop upon the lathe-bed, against which the saddle, F, is pressed, and also by the adjustment of the gouges.

The next and last operation is to hollow the sabot for the reception of the shell. For this purpose a similar lathe is employed, shown in Fig. 7, Plate 142; the block, A, is held in a universal chuck adapted to the article. The required hollow being part of a true circle, the gouge, B, is fixed upon a holder which is capable of turning on its axis by means of a handle, C; the radius of the circle described by the gouge depending on the distance at which its cutting edge is set from its centre of motion. The toolholder is mounted upon the saddle, D, of a lathe, as in the former operation, the depth to which the hollow is cut being determined by a stop fixed upon the lathe-bed and adjusted with reference to the face-plate. In performing the operation, the workman moves the saddle, D, with his left hand by a rack and pinion by means of the handle, E, while, with the other hand, he gently moves the handle, C, of the toolholder —making the gouge describe an arc of a circle.

It will thus be seen that no skill is required during any of the producing operations, and that the form and dimensions of the article are in each case contained in the apparatus. To make sabots of other forms, the several slide-rests are readjusted upon the saddle. The saving in wages effected by these arrangements amounts to more than four-fifths of the original cost.

For another, but smaller class of articles of similar shape, of which three or four hundred thousand are required daily, a different modification of the principle of copying is employed. The conical plug of the Minié bullet is made of boxwood by self-acting machinery. In this manufacture the conical form of the plug is contained in a revolving cutter which is fixed in a lathe spindle and driven at a high velocity. The wood having been first cut up into long square rods by means of circular saws, one of the wooden rods is fixed upon the lathe saddle and pushed forward against the cutter; this gives a conical form to the end of the rod, which is then cut off by means of a circular saw, forming a plug the required shape and dimensions.

The machinery for effecting this object is variously arranged; one of the best combinations is shown in Fig. 9, Plate 142. The headstock containing the cutter, A, shown full size in Fig. 10, in addition to the revolving motion of the spindle has a longitudinal movement imparted to it by means of the grooved cam, B, and the lever, C; the wooden rod to be cut, D, being held firmly by the saddle, E, the headstock and cutter are gently pushed against its extremity, thus forming the conical end to the rod, and are then withdrawn again.

The second operation is to cut off the plug. To accomplish this, the bed and saddle, E, carrying the wooden rod, D, are placed upon the top of a rocking-frame, which also is moved by a cam, F, and connecting-rod, G, but in a direction at right angles to the sliding motion of the headstock. When the conical end has been formed, and the headstock drawn back, the woodholder, E, is pushed transversely against the circular saw, H, and the finished plug drops into a box, I; after which the saddle, E, is brought back into line with the headstock, and an intermittent self-acting feed-motion, K, pushes the rod of wood forward into the position for forming another plug.

In some of the earlier machines the saw made a transverse movement to cut off the plug. By that arrangement the plugs and the chips were mixed together in the same heap, and the labour for their separation cost more than for their manufacture; but by the new arrangement, the plugs and the chip are kept separate, and the cost in wages is thereby reduced more than one half.

A modification of the copying principle employed in a machine for forming square holes or mortices in wood is another example.

It consists of a combination of a square box-chisel with a screw auger working within it, shown in Figs. 4 and 5, Plate 142. The chisel, N, forms a square socket of the same external dimensions as the required mortice, having its four cutting sides chamfered inwards. Within this chisel, and combined with it, there is a revolving screw auger, O, having an independent circular motion, its cutting edge being flush with that of the chisel. The action of the machine consists in forcing the square chisel against the wood with a pressure sufficient to make an incision, and the auger drills out about 7-8ths of the required hole, the chisel making the round hole square, and with its bevelled edges pushing the chips against the running auger, by means of which they are withdrawn.

The Blanchard turning lathe contains a modification of the copying principle, susceptible of endless application in the production of irregular forms; it is used in turning gun-stocks, spokes of wheels, shoe lasts, busts, and similar articles.

It may be described as two lathes placed side by side and parallel with each other, as shown in Fig. 8, Plate 142; the one lathe containing the pattern, F, the other the lump of material, G, out of which the article is to be formed, and both lathes having the same motion. The sliding rest, which holds the turning tool, H, also carries a dumb instrument, I, for tracing the pattern, F; and by means of a weight or spring this tracer is kept in contact with the pattern. As usually constructed, the turning tool, H, consists of a revolving wheel, having its periphery fitted with cutters, and driven by an independent strap at about 2,000 revolutions per minute. The tracer, I, is also of the same external circular shape and size as the tool, and is capable of turning freely on its axis. The action of the machine consists in imparting to the cutter, H, the motion of the tracer, I, as produced by the irregular surface of the pattern, F; the tracer being in contact with the pattern, as the latter turns round, the tracer moves out and in accordingly; and as the material, G, in the second lathe has the same motion as the pattern, and the cutter has the same outside form as the tracer, it necessarily produces the same shape as the pattern; and the slide rest that carries the cutter and tracer being made to slide along in the usual manner brings out the required copy of the pattern—one man being able to attend on several machines.

The Blanchard lathes employed in the workshops of the War Department are variously constructed. In some, the cutter and tracer are both mounted on a transverse slide-rest; in some they are suspended like a pendulum. In another, which is found to be a very superior arrangement, the tracer and cutter are mounted together on a rocking-frame, the centre of motion being near the floor. By both the latter modifications the friction is greatly reduced, and the actiou is more delicate in tracing the exact outline of the pattern than with the slide-rest motion.

A wheel fitted with cutters similar to that used in the Blanchard lathe has been employed with great advantage in forming different curves by means of a single instrument. This is done on the principle that if a piece of wood is passed under the cutting wheel in a line parallel with the axis of the wheel, it will form a groove corresponding with the circle of the wheel's circumference; but if the wood is passed along the face of the cuttiug wheel it will produce a flat surface. Curves between these two extremes are obtained by adjusting the apparatus to intermediate angles.

The manufacture of scabbard linings affords another illustration of this copying principle. The wood is first cut roughly into shape by means of the endless band saw. The next operation is to shape one side of the exterior surface. To accomplish this, the rough piece of wood is laid in a wooden holder which is susceptible of a longitudinal movement, and which, by means of guides, is constrained to describe a curve the same as that of the scabbard; this movement is made under a revolving cutter, having the transverse shape of the scabbard; the two combined motions produce the required form. The other side is formed exactly in the same manner—the finished side being laid in a holder of the exact form, in order to have the two sides placed exactly opposite to each other. These two operations complete the exterior. The third operation is to cut out the receptacle for the sword. The wood already shaped externally is laid in a holder into which it fits firmly, this holder being made to move in the proper curve under a revolving cutter the shape of the sword. It is then placed in a fourth holder over a circular saw to widen the upper end, in order to receive the thick part of the sword; after which the end is laid under a circular knife having a vertical movement, by means of which the point is cut to the proper shape. The accuracy of manufacture by this method is of course greatly superior as compared with the system of hand labour by means of which they have been made hitherto; also the rapidity of manufacture is greatly increased—two boys being able to produce 500 scabbard linings daily.

The same combination of movements is frequently arranged in a different manner, by means of which mouldings or such work can be formed on the edge of irregular surfaces. The circular cutter of the required form is placed on the top of a vertical revolving spindle, as shown at A, Figs. 11 and 12, Plate 142. The piece of wood, B, to be operated upon is fixed to a holder, C, which has been cut to the shape in the longitudinal direction. The operation consists in pushing this holder against a fixed collar, D, surroundiug the spiudle; consequently a combination of the form of the holder and also of the cutter is transferred to the piece of wood.

In the Small Arm Factory at Enfield that intricate piece of mechanism, the guu-stock, is produced entirely by machinery. It will be well understood how very difficult it is to make such articles perfect both in form and dimensions; it is comparatively easy to make things nearly correct, but to attain to perfect fitting from the machine involves conditions which are not ordinarily realised. With the machinery in question this absolute fit is secured at the rate of from 1,000 to 1,200 gun-stocks per week, leaving only the exterior smoothing to be done by hand. The object of the present Paper is not to describe the machines in detail, but only the principle of cutting, for it requires upwards of a dozen machines to produce a gun-stock, each being differently arranged to suit its special operation; but the general principle in all is the same, and if understood, may be readily applied in an infinite variety of ways for the performance of other operations.

The cutting out is effected by means of a revolving bit or drill, E, as shown in Fig. 13, Plate 142, made in the required form, and driven at a great velocity, 6,000 revolutions per minute; this being kept very sharp is capable of producing a clean smooth hole, and if pushed against the wood, F, sideways, or the wood pushed against the drill, will cut its way in any direction. In order to guide the drill in cutting out the required shape, there is placed alongside the gun-stock, F, a hard steel pattern, G, of the required form; and upon the frame which carries the drill, E, there is fixed a dumb tracer, H, of the same external form as the drill. This tracer being connected with the same framework as the drill, and both having the same vertical or horizontal movements, it follows that if the tracer is brought into contact with the pattern, G, the drill will be brought into contact with the wood, F, and will drill its way accurately according to the truth with which the tracer is pushed round the pattern.

Owing to the intricate form of the gun-lock, bits of different sizes are required to cut out the wood to fit it correctly; this is effected from a single pattern in the following manner. The machine is provided with a number of revolving bits of different dimensions, each accompanied by a tracer of exactly the same external form; and the machine is so constructed that each in succession can be brought into operation. At the commencement, the larger bits are introduced; these clear out wherever the larger tracers can find an entrance into the pattern; and having done their part, the smaller bits are substituted, and, at last, a very delicate drill, for touching off certain points too minute for its predecessors. Thus the whole operation is accomplished with the most rigid accuracy, and with a rapidity truly wonderful; for, including the fixing of the stock and the several changes of the drills, the whole may be performed under a minute.

The question naturally suggests itself, how can this accuracy be secured, seeing that the revolving drills are more liable to wear than the dumb tracers, and that such a condition must necessarily alter the dimensions of the recess produced by the drills, even if it give the proper shape? The method of compensating for wear is very ingenious, and deserves to be generally known. The conical hole in the end of the running spindle into which the drills are fitted is made very slightly eccentric; the drill is also made eccentric on its shank to the same amount. Both the end of the spindle and the drill are graduated round the circumference. When the drill is new it is set to run truly central, by placing the two eccentricities opposite to each other, and thus to cut cut its own diameter; but as by continued sharpening it necessarily wears, the time arrives when it requires to be altered in its position in the spindle, by throwing it slightly out of centre; and owing to the high velocity with which it revolves, any disadvantage arising from the eccentricity in the working is not perceptible, while the accuracy and correctness of the fit are rigidly maintained.

INSTITUTION OF CIVIL ENGINEERS.

(Continued from page 73.)

The Parliamentary Returns were nearly silent, with respect to Holyhead. It appeared, however, that the original estimate had been £600,000; but the expenditure, up to the present time, was £930,000. The utility of this work was undoubted; it was in the right place, and the Government had, at last, wisely placed it under excellent and judicious management. There was, however, an unfortunate error in the original design of the work,—the piers having been built concave in plan, instead of convex, towards the sea; thus making an angle in the construction, which was very prejudicial: and it was evident that if the plan had been originally well considered, nearly 200 acres more of harbour space would have been obtained, at the same cost. In fine, it appeared, that but little hopes could be entertained of more rational proceeding, on the part of the Government, so long as Commissions were constituted as at present. The few members of acknowledged independence were swamped by other members, determined by foregone conclusions, and the schemes proposed by certain parties were, by some " hocus pocus," generally recommended. It was evident, that no person should be placed upon such commissions, who was pledged to any system whatever; nor should the execution of any work be confided to any member of a commission, by whom that work had been recommended. There were many modes of carrying out these views; and if a better and more equitable method was adopted, the best professional ability and the greatest executive skill would be secured, to the manifest advantage of the country.

This subject was one which well merited the attention of some independent member of the House of Commons, who might do good service to the country by pertinaciously attacking and exposing the present objectionable system of executing all Government works.

It was explained that the superstructure at Portland, which was only commenced on the pier connected with the shore, was founded at the level of low water. It would have been better if the work had been commenced at 12 ft., or 15 ft. below low water.

As to open competition for Government works, the works at Portland had been submitted to six of the most eminent contractors in the kingdom.

What had been stated in the evidence in the Blue-books, was, that it was difficult to determine whether any absolute money-saving resulted from the employment of convicts, upon such works as those at Portland. Now, however, from a combination of circumstances, there was reason to believe that convict labour was rendered commercially advantageous. There were, however, advantages attending the useful employment of the convicts, which could not be estimated commercially;—the industrial and moral training to which they were subjected during their period of forced labour, tended to their reformation, and towards restoring them to society as useful men instead of outcasts. Thus, if the cost per lineal foot of the Portland Breakwater should be actually as great as that of another breakwater executed by free labour, there was still the advantage of the reformatory instruction and training given to the convicts.

It should be observed, that in the construction of a breakwater in an exposed situation, the cost would, in a great degree, depend upon the time the work was in execution, because in heavy weather the sea risk was greatly increased, when the quantity of stone tipped was limited by the want of facilities; whereas with the extensive means afforded by a long staging, such as had been created at Portland, the quantity of material deposited could be almost unlimited, and it could be done so rapidly as to diminish the sea risk.

The opening in the breakwater which had been alluded to was decided upon by the Commission on Harbours of Refuge, of 1845. The object was evidently to afford facilities to ships leaving the harbour during northerly winds; and hitherto no ill effect had been felt in the harbour from the admission of any heavy seas by that opening.

With respect to the plan of the pier at Holyhead, it was explained that when the harbour was first projected a strong and successful pressure was brought to bear by the Liverpool interest against the formation of a port in that locality; a small area only was, therefore, ordered to be enclosed. It was now found that this area was too small, and further works were imperatively demanded, which could only be joined on to the old pier by an extension in the direction that had been shown; and if there was an apparent error in the plan it must not be attributed to the late Mr. Rendel, by whom the works were designed.

It was explained, that this had not been intended; but what was the use of the controlling "nautical authorities," who were so active upon all Commissions, if they permitted such grievous errors of design simply because an outcry was raised by interested parties from another locality? These nautical authorities were not always so impressionable by just representations; and if they could not independently determine the requisite area of a new harbour, it might, with propriety, be asked, of what utility were they as members of commissions.

As to the employment of convict labour at Portland, the discrepancy between the statements by the two departments of Government had not been explained, and an annual sum of nearly £50,000 disappeared in some unaccountable way, without any satisfactory reasons being rendered. Neither were the beneficial effects of the moral and industrial training admitted, as the testimony of the warders of the convict establishment showed that real reformation was very rarely induced in any of the prisoners.

It was explained, with regard to the works at Alderney, that the section of the pier was exactly that which was so strongly advocated; the vertical wall was founded at 12 ft. below low water of spring tides.

As to Jersey, that place was, at one time, considered to be the most important of all the harbours in the Channel Islands; but some change of opinion appeared to have occurred, as the Government had only authorised the construction of one arm of the breakwater, and had neglected the other. The harbour was thus in such an unfinished and exposed condition that no vessel would go into it.

As to Dover, the expenditure was given in lump sums, in all the Blue-books, and the amounts now quoted as the cost per lineal foot were not correct, inasmuch as the gross sum embraced the cost of the landing jetties and other things, which should not be included, in making a comparative estimate of that work and contrasting it with others.

Before the plan of the Dover works was decided upon, the evidence of several eminent civil engineers was taken; the direction was then confided to Mr. Walker, and application for tenders for the execution of the work was made to six or more of the most eminent contractors, to one of whom it was let for a gross sum.

The breakwater at Dover could scarcely be contrasted with any other work, as at present it was essentially only a landing pier, although it would eventually form part of a harbour of refuge. The mode of construction was different to other works, as, owing to the absence of hard material in the neighbourhood, it had been necessary to resort to the use of concrete blocks, formed of cement and shingle. The result had been perfectly successful, as not a crack appeared in the walls, although the foundation was not good. The time actually occupied in executing the present length of pier was not any criterion of what could be done; at present a certain annual amount was ordered to be expended, for which so much work was executed; but at least double that quantity could be executed, if the necessary funds were voted for the purpose.

It was mentioned that the béton system had been first introduced by M. Poirel, in 1838, at Algiers. It had been tried there on a large scale, and had since been adopted at the new port of La Jolliette, at Marseilles. Where no better materials could be got it was thought worthy of the consideration of engineers; but as regarded cost, it was believed the price of béton would be found to vary from ten to twenty-two francs and upwards per cubic metre, according to the quality. This was nearly four times as costly, as some of the inexpensive stone breakwaters already alluded to, where the material was at hand, and was readily obtainable—at a cost, in the work, of from three to four shillings per cubic yard. In these cases the great expense of staging was saved by forming the breakwater like a railway embankment, and using the embankment itself as the stage from which to "tip" the material. Then, as the work advanced, the sea caused the materials to assume that inclination at which they would stand. This was spoken of as the simplest, the cheapest, and the best mode of forming a breakwater run out from the shore.

In reference to the remarks which had been made as to the harbour at Jersey, it was stated that by the original design it was to have been formed on the opposite side of the island, by excavating or indenting the land for the purpose, as had been done at Cherbourg. If that plan had been carried out, a useful work would have been obtained, at less cost than the present harbour.

With regard to a report that it was probable Parliament would be recommended to authorise the expenditure of about three millions sterling, in the construction of harbours of refuge, it was remarked, that that amount distributed over the coasts of the United Kingdom was so limited, that the cheapest plan of construction, combined with efficiency, must necessarily be selected. It was on this ground that a framework of carpentry, filled in with rubble-stone, had been mainly advocated; and it had been estimated that such a structure could be executed in deep water for £70 or £80 per foot. But, on the other band, it was thought a bold assertion to say, that this system was a good substitute for the stonework of the old school, for, in all probability, the first rough sea it had to encounter would destroy it; and, as far as economy was concerned, many stone breakwaters had been constructed at even less cost, where facility for obtaining materials had formed an element, as it always should do, in the determination of the site for the breakwater.

In allusion to a remark, as to the probable disintegration of the béton blocks, it was stated, that experiments, instituted in consequence of a failure at St. Malo, had proved that all rich limes, mixed with sand and pozzuolano, failed in salt water, though they succeeded in fresh water. Therefore, since 1852, the French engineers had used hydraulic limes exclusively in all sea works, and no failure had taken place. With reference to a statement that the works at Marseilles were not so exposed as similar works in many other places, and that therefore no fair conclusion could be arrived at as to the general applicability of béton blocks, it was mentioned that a large fort at Rochfort, in the Bay of Biscay, had been founded in 1802-3 on such blocks, 33 tons in weight, that they had remained perfectly stationary, and did not now exhibit any signs of disintegration. The breakwater at Cherbourg might be cited as an illustration of rapidity of execution in an exposed bay. The first cone was sunk in 1751, and the last in 1788—the distance between the two being 2 miles 3 furlongs. In the seven years, the whole of that length was brought up to within 4 ft. of low-water mark. The cost, including the pay of the seamen and soldiers employed, was about £300 per lineal yard. The additions to the superstructure made since 1832 brought up the total cost to £433 per lineal yard, and including the central battery, to £658 per lineal yard. This formed a striking contrast to the cost of the works at Dover, which it was found, from the Parliamentary Returns, had amounted at first to £800 per lineal yard, and in a depth of 7½ fathoms to as much as £1,245 per lineal yard.

It was remarked, that it would be interesting to ascertain the difference between the first cost of that portion of the pier at Blyth which had been built of stone alone, and that which had been constructed of timber and stone combined. In sea-works the slopes should be uniform, so as not to expose a number of angles to the wash of the sea. This principle had been kept in view in the sea embankments in Morcambe Bay, where the walls throughout were at a uniform angle with the foreshore, and at such a slope that the receding wave, instead of falling directly upon the toe of the wall, as would have been the case if the wall had been vertical, was modified to such an extent that the toe was easily protected, and suffered no injury.

Allusion was made to a pier which had recently been sent out to the River Plate. The piles were formed of four angle-irons, bolted together, and fitted with Mitchell's screws. The girders were 18 ft. in length, for convenience of shipping. When the materials arrived, they had only to be fitted and bolted together, and the structure was complete.

A description was given of a breakwater constructed for the South Australian Government at Port Elliott, Encounter Bay, about five years back. The work was carried out from the base of a headland of granite, blocks of the stone from 2 to 7 tons in weight being quarried and tipped down. As the work advanced, lines of rails were laid down on the top of the embankment, and the whole was finished at once to its full height. The blocks took their own natural slope, which was found to be about two horizontal to one vertical. About one hundred lineal yards were completed in rather less than two years. The top of the breakwater was 21 ft. wide, and 5 ft. above high-water mark. It was carried into a depth of 2 fathoms at low water, with a rise of tide of 5 ft. This work had stood perfectly well, though exposed to the full strength of the sea from the open Southern Ocean, and to a perpendicular lift of sea of 14 or 15 ft. The principle and construction of an iron breakwater, semicircular in plan, and 240 in length, designed by Mr. Hays, to protect the head of a landing pier at Holdfast Bay, near Adelaide, were then described. It was observed that this form of structure was equally applicable as a breakwater for harbours of refuge. The portion designed to resist the sea extended from a height of 6 ft. above high water to 12 ft. below low water. It consisted of a series of parallel plates of wrought iron, inclined at an angle towards the waves, and at distances of about 1 foot apart. These plates were firmly bolted together, and were supported upon wrought iron (Mitchell's) screw piles. The angle of the plates was intended to be such, as to be as nearly as possible in the plane of the motion of the water, by which the structure itself would be almost entirely relieved of the shock of the sea. It was thought that such a breakwater would be cheap in construction, rapid in execution, and would permit the free flow of the tidal currents, so as to avoid the risk of setting or stopping the travel of shingle.

It was remarked, that the power of the timber breakwater, described in the Paper, to resist the force of a deep-sea wave, depended upon two points,—the absolute stability of the work, and the force of the wave which it had to withstand. A consideration of the mechanism of waves, on which depended the correctness of the form of breakwater, seemed to show that the sections for deep water had less force to resist than those for shallow water; and the opinion was advanced, that the force of the waves at Holyhead was created by the breakwater itself, and that it would not be so much felt in the deep water. The case of a solitary wave of translation travelling along a channel of uniform section throughout, was first considered. It was shown that the facility of the propagation of the pressure increased as the square root of the depth—that the velocity of the forward motion of the particles under the crest of the wave was to the velocity of the wave as the height of the wave was to the whole depth, measured from the crest,—and that the momenta of the several columns, as regarded forward motion, was the same as if the volume of the wave was moving forwards, with the velocity of the wave.

It was manifest, that since the momentum, in all cases, was the same, and since destructive energy varied as the mass in motion multiplied by the square of the velocity, that the destructive energy of a large volume was less than that of a small one. When a wave met a sloping bottom, the velocity was retarded, and the wave rose and became shorter; consequently the number of particles in motion was less, and the distance moved through and their velocity were greater. This increase in height and of motion continued until a point was attained, when the motion of the particles was equal to the velocity of the wave. It then curled over and broke, when the maximum of the destructive force was attained. When there was an artificial foreshore in front of a breakwater it must cause the wave to break, and the force which was innocuous became extremely powerful. The waves of the sea were, however, oscillating waves, consisting of a succession of waves instead of a solitary one. If the force of a wave of translation in deep water was small compared with what it might become if converted by a sloping foreshore into a breaker, it followed that the force of an oscillating wave must be still less. It was found, that a wave rose considerably above its own height against a vertical face; the total height to which it rose being the measure of the pressure exerted upon the wall. In support of the truth of these principles, the breakwater at Alderney was referred to. The first wall consisted of large stones, as they came from the quarry, built with a batter of 9 in. to a foot, and founded, about low water mark, on a foreshore sloping downwards from that point. A length of 200 ft. of that wall having been swept away, it became necessary to reconsider the design. The new work, of which a length of from 600 to 700 ft. had been constructed prior to the storm of November, 1850, was founded 12 ft. below low water. The foreshore was carried down from that point to a distance of upwards of 100 ft., at a slope of 7 to 1; and having then reached 15 ft. below low water, it dropped at the natural slope of 1 to 1. The rise of the tide was 17 ft., and the wall was 25 ft. above high water. In the great storm, the waves were observed to curl over above the parapet, and to break upon the wall with considerable force, The stone was hard quartz grit, that in the foreshore being sharp and angular, and so great was the action of the sea, that the stones became rounded and smooth, and the face of the wall was polished. From these remarks it was concluded, that the perpendicular wall from the bottom was the true form for breakwaters, and that the forms proposed in the Paper were based upon correct principles.

In reply to the remarks of the different speakers it was observed, that the proposed system of construction differed materially from the wooden piers described as having been erected in the River Wear seventy years ago. The carcasses, in the latter case, were said to be loaded with large stones, whereas the Blyth section was not a box, but a framework entirely open at the ends and bottom, and partly at the sides; it had, therefore, no power to float stones. It was also submitted, that in deep water, or even in shallow water, with an irregular rocky bottom, it would be impossible to carry out the system of carcasses. All, however, that was claimed in the proposed system was an improvement in the mode of construction, although it was believed that a similar work had never been described nor constructed before; certainly it was quite different from the caissons carried out at Genoa. With regard to the cones at Cherbourg being identical, it was impossible to imagine anything more dissimilar, for the cones were entirely isolated, at intervals of several hundred feet; whereas one leading advantage of the proposed system was the continuity of face, whereby every part of the work received support from the neighbouring portions. No doubt wooden piles, with or without stone thrown behind them, had been used in this country and elsewhere, but that system was only applicable to moderate depths. But piles were not intended to be used, for they were inapplicable in a hard rocky bottom and for great depths. As to the assumed difficulty of erecting the frames, it was stated that when set up on end they were not like a mass of timber floating loosely, as they rested on the bottom by their own weight, and had no floating power, a great part of the mass being above the water. Attention was then directed to the difference between the action of the sea in shallow and in deep water. In the former, the waves necessarily broke on the work, whereas in deep water, and with nearly vertical faces, the waves did not break. If, therefore, any given work would resist the impact of the waves in shallow water, it would be much more likely to do so in deep water. At Blyth, a comparatively fragile work had withstood the full force of the waves of the German Ocean; and to show the power of the sea there, it had been known to move a stone 9 tons in weight, and to lift a stone 3½ tons in weight up a perpendicular face 4 ft. high.

As to the objection that the stability of the intermediate frames might be affected by the settlement of the rubble bank, it was remarked, that the bank was deposited and allowed to settle before the frames were erected. When the frames were placed, the stonework was only carried up to the underside of the cross-ties; and even should any settlement take place afterwards, the lower tie, being a chain, was not affected by it, and it could not affect the uprights. When this hearting had become consolidated, the upper part of the work was filled with stone, and dry walls were built along each cross-tie, so as to prevent any settlement of the superincumbent stone from injuring them. With reference to the proposed plan of breakwaters with upright walls, to be constructed of large masses of concrete, it was remarked, that the parapet had been altogether omitted. The parapet might be dispensed with in such a case as Plymouth, where the sea was broken by the long sloping foreshore, and therefore entered the harbour as broken water; but with such a section as that described, the mass of the wave would go right over the supposed breakwater into the harbour. In regard to the cost of the Portland breakwater, if the preliminary expense of £80,000 or £90,000 were distributed over the whole intended work, being a length of 8,000 ft., instead of over the 5,907 ft. already completed, that would only reduce the cost given in the Paper by £4 per foot run. As to the employment of convicts involving a larger plant, it was observed, that the only part of the plant affected would be that used in the quarries, being but a small part of the whole, and the cost of which would not amount to above a few pounds per foot of the work.

The proposed system had been explained generally, and the principles upon which it was based stated, without those details being entered into, which might require to be modified to suit particular localities. It appeared to have been overlooked that the timber system had been advocated as the backbone of a permanent stone structure. Viewed in this light, a comparison was instituted between two breakwaters, identical in form, in external dimensions, in material, and in prices; the one constructed under the most improved of the existing systems, and the other under the new system. It was found that for a length of 2,000 yards, in a depth of 52 ft. of water, the former would cost £718,934, and occupy twenty-one years in construction; whilst the latter would only cost £538,622, supposing the creosoted timber to last twenty years, or £600,585 if the timber only endured ten years, and would afford the same amount and kind of shelter in five years. The progress of the ordinary stone breakwaters was limited by the time required for the erection of the superstructure, as the rubble bank could always be formed with sufficient rapidity. Under the new system a harbour would be enclosed in five years, instead of in twenty or twenty-one years, on the old system; and the timber breakwater would afford great facilities for the construction of the faces, as there would be no current to contend with, and the work might be proceeded with at many different points at the same time, instead of being confined to one spot.

February 15 and 22, 1859.

Joseph Locke, Esq., M.P., President, in the Chair.

The discussion upon Mr. Jameson's Paper, On the Performance of the Screw Steam-ship "Sahel," fitted with Du Trembley's Combined Vapour Engine; and of the sister-ship "Oasis," with Steam Engines worked Expansively, and provided with Partial Surface Condensation, occupied both evenings.

In commencing the discussion, it was observed, that experiments, made with great care and continued over some time, induced the opinion that surface condensation would ultimately supersede condensation by injection. It was found that a condensing tube 4 ft. long, and ½ an in. in diameter, would be sufficient for a non-expansive engine of 1-10th H.P. Such a tube, placed concentrically within one of slightly greater diameter, so as to allow only a thin stratum of condensing water to pass between the two, would condense 3 lbs. of water per hour; the pressure in the condenser being only 0·96 of an in. of mercury, the temperature of the condensed water 24° centigrade, and the temperature of the condensing water, before and after doing its work, 7° and 18° centigrade respectively. The same tube would condense 30 lbs. of water per hour, the pressure in the condenser being 23·2, the temperature of the condensed water 85° centigrade, and the temperature of the condensing water, before and after doing its work, 8° and 36° centigrade respectively. An approximate formula for determining the vacuum in any particular case applied to the same condensing tube might be thus expressed:—The deficiency of the vacuum in the condenser, compared with that due to the temperature of the condensed water, was directly proportional to the quantity of water condensed in a given time, and inversely to the difference between the temperature of the vacuum and that of the condensing water.

A further account was then given of the voyage made by Mr. Rennie, in the ship *Du Trembley*, in the year 1853, from Marseilles to Stora, in Algeria, and back. From this it appeared that there was a saving of fuel of from 50 to 60 per cent., and consequently that an increased amount of space was available for cargo. This advantage was partly counterbalanced by the cost of the ether, and the inconvenience and possible danger of its use, particularly in hot weather, when the vapour was at times diffused over the vessel, and became very inflammable. But these defects might yet be remedied.

It was remarked, that the difference in the consumption of fuel in the combined engine and in an ordinary expansive engine, being respectively 3·1 lbs. and 7·4 lbs. per indicated H.P. per hour, seemed to indicate the superiority of the former system. But before accepting this conclusion, it was desirable to examine the conditions of the experiment. In the first place, it was evident that there was a bad vacuum in the ether cylinder, which might be attributed partly to the difficulty of condensing that liquid, and partly to the exhaust ports being insufficient in area; for ether steam being five times heavier than water steam, the ports for its discharge should be twice the usual area. On the other hand, it was doubted whether in the expansive engine the cylinders had been properly protected; and it was stated that a loss of 50 per cent. had been known to occur from condensation in an unprotected cylinder when working expansively. It seemed, therefore, essential to inquire into the relative merits, in a theoretical point of view, of the combined ether engine, and a well-arranged expansive steam engine. According to the dynamic theory of heat, heat and power were identical. The particles of a heated body were in a more agitated condition than in a cooler body, the motion of the particles being greatest in elastic fluids, and their pressure upon the sides of the vessel such, that if one side yielded, as was the case with a working piston, the reaction would be less than the impact. Hence the motion of the particles would be diminished in proportion as the piston was urged forward, and the result would be reduction of temperature. Expansion might be carried to a point where the elastic force was entirely exhausted. Commencing with steam of the density of water, and expanding it, until a perfect vacuum was obtained, would form, in point of principle, a perfect engine. But the practical difficulty of carrying expansion to its utmost limits was the great strength and size of cylinder required for the purpose. All the different air and other engines, designed to supersede steam, had aimed at one point, that of carrying the expansive action to a further degree without its being necessary to resort to such large and strong cylinders. In the combined engine, the analogy was evident. The expansive action was stopped at a certain point, and the steam was made to impart its heat to another liquid, which evaporated at a lower temperature, and the vapour of which occupied less room than steam, at a given temperature; so that a smaller cylinder could be employed. It was a matter for calculation, whether this advantage was sufficient to balance the disadvantages of an imperfect vacuum, in both the steam and the ether cylinders of the complications, and of other drawbacks which had been mentioned in the paper. It was believed, that by properly protecting the ordinary steam cylinders against the loss sustained from condensation, results would be obtained equal to those claimed for the ether engine.

It was remarked, that a theoretical comparison of the relative merits of the ether, or combined engine, and of an ordinary steam-engine, was in favour of the former, as there was, undoubtedly an addition of power. With reference to the possibility of improving the ordinary steam-engine, by carrying the expansion of the steam to the furthest practicable point, and thus utilising the maximum calorific power, that was a problem of great complexity, the practical solution of which had not hitherto been attained. It was thought that the apparent difficulties in dealing with ether, should not be considered an insuperable obstacle to ultimate success. The present leakage at the joints required attention, as it involved waste of ether, and increased the chance of danger. There was no apparent reason why this should not be accomplished, as although ether penetrated more readily than water, and thus necessitated a better joint, yet it was not a corrosive liquid, and had no appreciable action upon metals.

It was believed, that the right way of looking at this question was to compare the performance of the combined marine engine—first, with ordinary marine steam-engines, made by experienced makers; secondly, with the most economical engines working on land; and thirdly, with a theoretically perfect engine. With regard to the first point, it was found that the use of the combined engine, setting aside the cost of the ether, effected a saving of two thirds, or one half, in the consumption of fuel. In the second place, 2 lbs. of coal per indicated H.P. —the ascertained consumption in the *Kabyle*—represented one hundred millions of duty in a Cornish engine, which was very good work, many engines doing much less; therefore, there was an engine used for steam navigation as economical, in point of consumption of fuel, as some of the best engines employed for pumping. The third comparison, that an equal amount of economy would be gained by a proper expansion of the steam to a low point, without the intervention of ether, might be answered by the fact, that marine steam-engines continued to be made which consumed at least one-half more fuel than those under the combined system. It should be borne in mind, that where the practice was pursued of working steam very expansively, more fuel per indicated H.P. was stated to be burnt than when working with full steam; at all events, the expected economy was not produced. As regarded the question of the leakage of the ether, the waste was now so small, that it was commercially worth while to use it, and thus to effect a saving in the consumption of coals. The vapour caused little or no inconvenience. It was not simply whether the cost of the ether was equal to that of the coals saved, for the space which the coal occupied in the ship must be taken into consideration. The danger was not greater than was incurred in the use of gas in a dwelling-house, and no objection could be made to the system on that ground. An explanation was offered, as to the reason why the system had not been employed in England. As an illustration of the difficulty of getting any new invention tried in this country, it was mentioned that an offer had been made to a large steamboat company, to apply the vapour-engines to a vessel of 60 H.P. free of cost to the company. Their performance was to be tested on land before being placed in the vessel, and if, when fitted in the ship, an economy of 25 per cent. was not obtained, then the ordinary engines were to be replaced without expense to the company. This offer was rejected, the company giving as a reason that they did not like trying experiments. It had been stated that other fluids than ether might be applicable. The bi-sulphide of carbon was cheaper, gave more bulk of vapour, and was in every respect a more desirable liquid than ether. A description was then given of a modification in the method of effecting a junction between the wrought-iron tube-plate and the tubes of the vapouriser, which also acted as a steam condenser. When thus constructed, it was proved with air pressure, and the loss was ascertained to he only 1 lb. per hour, so that it was practically tight.

Some remarks were then made to show how objectionable it was to work without a steam jacket to the cylinder, especially when using steam very expansively, as the cylinder then became a condenser at the commencement, and a boiler at the end of the stroke. Great credit was due to M. Du Trembley for introducing a system for concentrating the light pressure of the long end of an expansive figure; but it was not thought that any more power could be obtained from a given quantity of heat by this means, than by the proper use of steam.

It was thought that the vapour engine should have been compared with a pumping engine, and not with an ordinary marine engine, as the actual efficiency of, and the real duty performed by, the latter could not be ascertained; whilst the load upon a Cornish pumping engine was a known and definite quantity. For comparison, in respect to load, engines should be divided into three classes:—first, the Cornish engine, in which, with a known weight at the end of the beam, an effort was exerted in each succeeding stroke of similar and equal value. Secondly, with a factory engine, working with a load, which might be, but was not generally known. Thirdly, with a marine engine, in which the load on the engine could not be stated, as there were no means of determining or measuring the friction of the vessel. One of the chief peculiarities of the pumping engines, constructed on the Cornish principle, was the employment of a steam jacket around the cylinder, and in direct communication with the boiler, the cylinder being situated at a higher level than the boiler. It was now also frequently the practice to surround the jacket in addition, with a coating of ashes 12 in. in thickness. The amount of benefit derived from the use of the jacket was capable of being precisely determined. It had been ascertained that the water converted into steam, to keep the jacket warm, amounted to 1-45th part of the whole quanity of water used as steam in the cylinder. In Cornish pumping engines the pressure of the steam in the boilers and the jackets was 35 lbs., whilst on the piston it never exceeded 25 lbs., and when working expansively it did not amount to more than from 10 lbs. to 20 lbs. In applying expansion to marine engines, it was the custom to expect, in ordinary working with full steam, that there should be the same pressure on the piston as in the boiler. But if the same amount of effort was to be got in one stroke of an engine, when worked expansively, as when using full steam, then the initial steam must be considerably higher to allow to a certain extent for the cutting off.

It was urged that the true measure of the efficiency of an engine was the quantity of water passing through it, as steam, in a given time, and that the application of meters to engines would enable this to be ascertained with accuracy. This was considered preferable to recording the quantity of coals burnt; because when the duty, with a given consumption of fuel, was stated that represented the degree of attention of the stokers, the quality of the coals, the construction of the boilers, and the perfection of the engine combined; and it was well known that the coals and the boiler might cause a variation to the extent of 50 per cent. in the quantity of steam generated. It was also contended that there was no practical value in the employment of ether, and that if high pressure steam was used, expanded in a double cylinder engine, with proper precautions against radiation, equally economical results might be expected.

It was observed that the discussion, so far, had reference principally to the administration of steam in an ordinary engine, rather than to the combined vapour engine described in the Paper. It had been said that high-pressure steam, used very expansively, would lead to as economical results as the ether engine; but it seemed to be forgotten that the latter was made the means of utilizing the temperature of the exhaust steam, and that by this system, after the most favourable results had been obtained by the use of steam alone, a still further economy might be produced by the addition of the ether engine. It was a means of utilizing 5° or 6° of temperature which were ordinarily lost, to boil another liquid to produce another atmosphere.

It was admitted, that the arrangements of the combined engines were admirable, and the workmanship excellent, all the joints being apparently tight. The experiments, on the whole, had been made in a most satisfactory manner, and seemed to induce the belief that the difficulties still to be overcome were but few, that the danger was less than had been anticipated, and that the use of two liquids, evaporable at different temperatures, might hereafter be profitably introduced.

It was agreed, that if ether was used in combination with steam, as in the "Sahel," as much duty might be performed as with steam alone, used expansively; but it was believed it could be shown, theoretically, that a higher performance could not be obtained. To boil ether, the vacuum in the condenser of the steam cylinder must be reduced to 6 lbs. or 7 lbs. per in. less than in the condenser of an ordinary steam-engine worked expansively. Again, an inch of water would produce about a cubic foot of steam, at the pressure of the atmosphere, but the same quantity of ether could only produce about one-eighth of a cubic foot of vapour at the same pressure. Therefore, it was believed, better results would be obtained by using steam expansively in a cylinder entirely cased with a steam jacket, and combining other recognised improvements.

Some recent experiments on steamboats gave the following results:—

No.	Name of Vessel.	Absolute pressure of Steam on admission	Rates of Expansion nearly.	Consumption of Coal per I. H. P. per hour.
		Per sq. in.		
1	Admiral	34 lbs	5	2·95 lbs
2	Callas	38 ,,	$6\frac{2}{3}$	2·7 ,,
3	} Not yet	63 ,,	8	1·88 ,,
4	} named	106 ,,	15	1·018 ,,

It was observed that the last experiment was incomplete, as it had been stopped by a fog. In reference to the combined engine, it was stated, that theory showed, that for a given initial pressure and temperature of steam the combined engine must be the more economical, because of its enabling a lower limit of minimum temperature to be reached, and diminishing the loss by overcoming back pressure and friction; but it appeared, that by using a high enough initial pressure and temperature of steam the steam-engine could always be made equal, or superior in efficiency, when required.

It was thought, that expansion in marine engines might be resolved into two considerations:—First. Could a pound of steam develop more power, when used very expansively, than when carried to the usual point of about three-fourths the length of the stroke, before cutting off, as in the ordinary full-powered marine engine? Secondly. Was the expenditure of coal per I.H.P. increased, or diminished, as expansion was extended. A series of trials, with H.M.S. *Renown*, *Victor Emmanuel*, *Algiers*, and *Racoon*, showed, that when only half the number of boilers was used and the steam was worked expansively, being cut off at 6·5 of the stroke of the piston, more than half the power was developed, which was given out by all the boilers, though the excess was not considerable. As to economy of coal, it was stated, that in H.M.S. *Dee*, with steam jackets embracing the cylinders, the consumption of fuel, when working at full power, with common steam, amounted to 3·9 lbs. of Welsh coal per I.H.P. per hour. When the steam, after leaving the boilers at a temperature of 237°, had been super-heated to 377°, the result was 2·74 lbs. per I.H.P. per hour. In this case, the steam was cut off at exactly half the stroke. It was found, that when cut off at an earlier portion of the stroke, the consumption of fuel was immediately increased. The most economic result, when working at full power, and with superheated steam, was 2·97 lbs. per I.H.P. per hour. The advantage in H.P. by expanding beyond the half stroke, was more than compensated by the increased consumption, when working beyond that point, in ordinary marine engines, with steam of a pressure of 20 lbs. It was of great importance that the mean temperature in the cylinders should be such as to prevent condensation. With regard to the use of high-pressure steam in marine condensing engines, it was observed, that the difficulty with the Government gun-boats and block-ships, in which steam of a pressure of 60 lbs. was employed, was to insure, for any length of time, the necessary tightness in the tube plates, whether of iron, or brass. The consequence of any failure in this particular point was, that the ends, not only of the leaky tubes, but of all those around them, became incrusted in a short time, and all the lower tubes were so plugged up, as frequently to require boring-tools to clear them. Surface condensation might have the effect of preventing this leakage aud of obviating the incrustation of common salt and the closing up of the tubes, in which case the boilers would become like those of a locomotive engine.

It was said, that the mechanical arrangements of M. Du Trembley's engine were fairly entitled to great praise. That engine presented a theoretical and practical advantage in utilising the waste heat of the condensing water, supposing the ether vapour to be eliminated, without the necessity of costly apparatus. But still it was felt that attention should first be directed to a system of perfecting the ordinary marine-engine, rather than obtaining more favourable results by the addition of the ether system to the present engine. A marine-engine, with proper adjuncts for using steam of from 45 lbs. to 60 lbs. pressure, precautions being taken to economise the heat at a high temperature, and the difficulties in the way of dry and rapid condensation being successfully overcome, would, if the laws of heat and elasticity were to be believed, result in greater economy, with more safety than was promised by the combined system. In such a case, the consumption of fuel might be reduced even below 2 lbs. per indicated H.P. per hour, as the result of ordinary working, not of a series of short experiments, the results obtained from which could rarely be received or recognised as facts. When this economy was accomplished, M. Du Trembley's system could, if it was hereafter thought desirable, be adapted to the then existing arrangements.

It was considered, that the subject had been treated in the paper rather in a commercial than in a scientific point of view, and that the gross consumption of the fuel as it had been taken, was a loose standard to adopt. It was argued, that the combined vapour-engine should not be compared with theoretical marine-engines, working at very high pressures, for whatever pressure was employed in the ordinary engine, might be used in the combined system. It was shown, from indicator diagrams, taken when high pressure was used, that the power of steam was equal to the power of the vapour of ether. It also appeared, that whatever power was gained in the ether engine was so much deducted from the steam-engine. Therefore, theoretically, there could be no gain by the adoption of the combined system. But a practical advantage might result by reducing the consumption of fuel from 3 lbs. or 4 lbs. per indicated H.P. per hour to 2 lbs. per indicated H.P. per hour. The present steam-engines were constructed for fixed gases rather than for saturated vapour. One of the chief reasons why the combined engine was practically more economical than the marine engine, was that in the latter, when the steam was used expansively, there was a certain amount of condensation and re-evaporation going on in the cylinder, as had been previously explained. But if the heat of the cylinder was maintained, and its size was increased, this effect would disappear. To produce the most favourable results, it was contended, that the surface of the condenser should be equal to half that of the boiler.

In conclusion it was remarked, that if the steam could be so expanded as to leave the cylinder at a temperature of only 60°, then there would be no advantage in the combined system; but it was difficult in a marine engine, to have a cylinder sufficiently large for the purpose. From some experiments which had recently been made, it was ascertained that the latent heat of ether was 175° Fahrenheit, equal to 97·3° centigrade. This result agreed nearly with the estimate given by M. Du Trembley, who stated it to be 96·12° centigrade. The difference might be accounted for by the apparatus employed, and the process followed not being the same in each case. The former was deemed to be the more correct figure, and the mode in which it was obtained was described in detail. It was also found that the heat required to generate ether vapour was less than that necessary for eliminating steam, in the proportion of 76 to 96.

After the meeting of February 1st, Mr. Denison, Q.C., exhibited a small crab, or winch, capable of lifting half a ton with a single pulley, although light enough to be carried in one hand. It had two short barrels with five grooves in them for the rope, and a wheel at the end of each barrel, both of which were driven by equal pinions on the winding arbor. The rope passed from one barrel to the other; and the loose end was either pulled off by hand, or fell by its own weight, or by the weight of the descending blocks, or empty bucket attached to it, if the crab was worked alternately, like buckets in a well. This avoided the loss of power and increased strain on the wheels, from the accumulation of rope on the barrel when worked in the common way, and the loss of time in fleeting, or passing the four or five coils of rope, back from one end of the barrel to the other (which required special apparatus for it), and brought the whole machine into a smaller compass, with less weight than a common crab of the same power, because thinner and smaller wheels could be used, on account of the strain upon them being always uniform in lifting any given weight, and because the barrels need not be longer than five times the thickness of the rope.

Several members stated that the machine was a very good one, but it had been invented long ago, and was now in use in many factories. To this it was replied, that it was surprising that so valuable an improvement of such a clumsy machine, as the common long-barrelled crab, should have been unknown to the various engineers, builders, and other persons conversant with such matters, to whom it had been shown or described. It was found that the time spent in fleeting the chain was no less than a quarter of the time spent in actually lifting the Westminster bell to the top of the tower, and two crabs were used for it, whereas, with one such machine as this, it could have been lifted the whole 201 ft. without any interruption. Some persons to whom it had been described, before they had seen the present machine in action at Mr. Dent's clock factory, doubted whether it would answer; some said it was just what they wanted; some were surprised that it had not been invented before; but not one of them appeared to have had the least idea that it had not only been invented before, but that it was in common use, as was now stated. The only object in bringing the machine to the Institution was to make it generally known, and to show its convenience; and it was hoped that the present conversation would assist in doing so, as it probably would, even more completely than if the invention had been really new and comparatively untried. There were some details of construction for diminishing friction in machines of this kind, which would be gladly explained to anyone who might think it worth while to inquire about them, as they might not occur to everybody who merely set to work to make such crabs, from the general description which had been given.

March 1, 1859.

JOSEPH LOCKE, Esq., M.P., President, in the Chair.

THE Paper read was ON THE CO-EFFICIENTS OF ELASTICITY AND OF RUPTURE, IN WROUGHT IRON, IN RELATION TO THE VOLUME OF THE METALLIC MASS, ITS METALLURGIC TREATMENT, AND THE AXIAL DIRECTION OF ITS CONSTITUENT CRYSTALS, by Mr. R. Mallet, M. Inst. C.E.

It was assumed, that amidst the numerous theoretical treatises upon and practical investigations into the strength and other properties of iron, the two questions which formed the prominent feature of the author's present experimental inquiry had remained comparatively untouched. The conditions of manufacture and the resultant qualities had been hitherto too lightly passed over.

Iron was formerly entirely worked under tilt hammers; the process of rolling was then introduced, and now, in consequence of modern engineering requirements, masses of iron, of considerable magnitude, were produced by faggotting together under heavy forge hammers, from large numbers either of bars or slabs grouped together. The masses were not, however, found to possess ultimate strength in proportion to the number of bars of which they were composed; in fact, it appeared that the strength of the mass became less in some proportion as the bulk became greater. This was admitted as a fact, but no one had hitherto attempted to show experimentally, what function of the magnitude was the strength of a given kind of iron, manufactured in a given manner; or how the same forged mass, when very large, differed in strength, in different directions, with reference to its form; or how the mechanical part of the process of manufacture of the same iron affected its actual strength, either as a rolled bar or as a forged mass.

Addressing himself to this investigation, the author dealt generally with three points of the inquiry, viz.:—

1°. What difference did the same large bars of unwrought iron afford to forces of tension and of compression, when prepared by rolling or by hammering under the steam hammer?

2°. How much weaker, per unit of section, was the iron of very massive hammer forgings than the original iron bars of which the mass was composed?

3°. What was the average, or safe measure of strength, per unit of section, of the iron composing such very massive forgings, as compared with the acknowledged mean strength of good British bar iron.

In the investigation of these questions, other subordinate but very important points arose; such as the determination of the relative longitudinal and circumferential strength for equal sections of the iron in massive cylindrical forgings.

The proper measure of the strength of iron, or any imperfectly elastic material, was the "work done," whether by extension, compression, rupture, or crushing, due to any force applied to it. The co-efficients Te and Tr were designed by Poncelet, to express this "work done," by an extending or compressing force upon any elastic prismatic body at the point where its elasticity became permanently impaired and its form distorted, and at the further point where rupture occurred. The method of arriving at these co-efficients was then given, and it was shown that though they were not sufficiently attended to in practice, yet that they were the true measures of the safe and ultimate resistance of materials when applied constructively in machines or otherwise.

The crystalline structure of iron was then considered, and quoting from the author's communication to the Royal Irish Academy (*Trans.* Vol. 23, p. 1, 1855), it was shown to be a law that "iron, whether in the state of cast or of wrought iron, has the principal axes of its integrant crystals arranged in the lines of least pressure within the mass."

If consolidation from fusion took place undisturbed, as in cast iron, the principal axes would be arranged in the directions in which the heat-wave had passed outwards from the body, in cooling; which would be perpendicular to its surface contour,—those being the directions of least pressure of the internal constraining forces, produced by contraction in cooling, which were necessarily parallel to the planes of external contour.

The effects of rolling and of hammering masses of wrought iron of different contents, were then treated of, and it was shown, that what was termed "fibre" was the longitudinal extension of the principal axes of the crystals. The original development of these crystals, under the constraining forces due to change of temperature, &c., was, "cæteris paribus," proportioned to the time given for such development. Thus, in very large forgings, the crystals were generally extensively developed, in consequence of the length of time which the mass had been under the operations of heating and forging.

It had long been admitted, that large forgings became weaker, in proportion as their bulk was increased, but as no definite ratio was recognised, it became of importance to fix the conditions of strength in wrought iron, under various circumstances. The author was enabled to undertake this investigation, under the authority of the Minister of War, and with the concurrence of the Royal

Society, when making the forgings for the two 36-inch wrought iron mortars, constructed on his designs for the Government; he then selected specimens of iron, upon which the experiments of tension and compression were tried.

The methods were then explained, by which the specimens of iron were obtained from the large masses, and the apparatus was described, by which the observations were made, when the specimens were undergoing the operations of extension and compression. In cutting and boring into the massive cylindrical forgings, to obtain the pieces of iron from the various parts, it was invariably found that there existed, internally, large transverse rents, with jagged and crystalline irregular surfaces, the opposite faces of which were counterparts, and presented distinct evidences of having been torn asunder by contraction from the centre towards the circumference, as the mass cooled. The rationale of the phenomenon appeared to be, that this action was simply due to the contraction of the external shell, before the temperature of the centre had been perceptibly lowered; this in its turn was cooled, and in contracting produced these visible rents, or fissures, and no doubt caused other minor dislocations which detracted from the general strength of the mass.

This was evidently the cause of the difficulty of obtaining very large forgings of a cylindrical form, quite sound; as, if the diameter was sufficiently great, all such cylindrical forgings, so built in construction, and so treated by heating, hammering and cooling in manipulation, must become unsound internally, by the opening within the mass, of one, or more of these rents, in the direction of the axis, during the process of cooling. In solid cylinders, or conic frustra, it must occur whenever the dimensions were such that the total amount of the contraction of the metal, in any one diameter, from its highest temperature, down to that of the atmosphere, as fixed by the circumference of rigidity due to the outer cold shell, exceeded the limit of extension of the iron at rupture, due to the length of the diameter of the interior core, which cooled last. This was the theoretic limit of size of forging, beyond which internal rents must occur. The practical illustration was, that almost all cylindrical shafts of wrought iron, exceeding 12 in. in diameter, were found to have one or more of these rents in them, thus having their strength impaired. This reduction of strength was altogether distinct from any deterioration of quality of the metal, arising from its being alternately heated and cooled and hammered.

The remedy for this play of molecular forces, was to construct and work the large forgings hollow. This course had been pursued with success at the Mersey Iron Works, Liverpool. When a cylinder had a large concentric cylindrical hole along its axis, it cooled at the same time, though not equally, on both the internal and the external surfaces, and thus the extremes of internal strains were avoided, and the hollow centre yielded more readily to the forcible compressive grasp of the exterior.

A minute description was then given of all the irons which had been experimented upon, specimens of each being exhibited at the meeting. They were divided into classes, according to their several characteristics and modes of working, and into the most analogous class was imported Clay's paddle-steel, a comparatively new material, which had been brought into this investigation for the purpose of comparison, and the results were such as promised to be of great practical importance. The general results were the separation of the several classes into two grand divisions: 1°. The crystalline, or sub-crystalline in fracture, which were always the result of manufacture by the hammer. 2°. The fibrous, or crystallo-fibrous, which were always produced by the rolling process, but which might be produced by careful and continuous elongation under the hammer.

The very weakest wrought-iron of all those experimented upon was found to be that cut transversely from the end of a very heavy cylindrical forging, which had been exposed to heat and percussion for nearly six weeks. Exposed to tension, its elastic resistance was only $3\frac{1}{4}$ tons per square inch, which was less than the average of cast iron; thus, as regarded pressure, it was the very weakest iron produced by any method of manufacture; whilst the faggot bars, of which the mass was built and welded up, bore a tension of upwards of 12 tons per sq. in. before losing their elasticity, and of nearly 23 tons at rupture, and a pressure of nearly $21\frac{1}{2}$ tons before losing elasticity, and of nearly $27\frac{3}{4}$ tons at the point of total distension or crushing, thus proving the fact, that the extreme weakness of wrought-iron in heavy forgings was not due to any metallurgical alteration in the constitution of the metal, but to changes in its state of aggregation, induced by the process of forging, by the long-continued and unequal heating, and by the hammering.

Hence was deduced the conclusion, that practically the iron of very heavy shafts, forged guns, huge cranks, and other similar masses, might be expected to become permanently set and crippled at a trifle above 7 tons per sq. in., and to give way by fracture at about 15 tons per sq. in. by tension, and to completely lose form at pressures of from 15 to 18 tons per sq. in. Therefore it followed that allowing a deduction of one-half, as sanctioned by practice, from the elastic limits of tension and of pressure for the margin of safety, the iron of such forged masses should not be trusted for impulsive strains exceeding about $1\frac{3}{4}$ ton per sq. in. of tension, and about $4\frac{1}{2}$ tons per sq. in. of pressure, or for passive tensile strains of $3\frac{1}{2}$ tons per sq. in., or for passive pressure beyond 9 tons per sq. in.

Further experiments demonstrated, that in heavy rectangular forged slabs of upwards of 12 in. in thickness in the plane of the slab, the resistance to all the forces was much higher, and hence large cranks, which were usually cut out of such rectangular forgings, were stronger than the shafts to which they were attached, in the ratio of 8 to 6. The physical cause of the difference in strength between large cylindrical and rectangular forgings, although made from the same original material, was to be found in the difference of the molecular arrangement. The integral crystals of the cylindrical masses were strained, distorted, and partially separated by the effects of hammering in various directions, and by the peculiar constraining forces due to contraction in cooling; whereas none of these forces acted to the same extent upon rectangular masses; which were only hammered in three directions, and the constraining forces of cooling were all parallel to the faces of the parallelopiped, or in three directions only.

A special peculiarity, noticed in heavy forgings, was the sudden and extreme inequalities of texture and of strength, found in different and even in closely adjacent portions of the same mass, producing great uncertainty of result in practice.

Another peculiar feature was, that the rates of extension or of compression did not move uniformly, but by fits and starts. This phenomenon obviously arose from the *per saltum* disintegration of planes of crystallization, and their more or less complete separation in a crystallized but yet ductile body. This had never been observed in fibrous irons, or in those in which the finely elongated crystals were all rolled parallel and in the line of the length of the bar or the sheet.

If the original, or integrant faggot bars, from which a heavy forging was built and welded up, had a tensile elastic strength of 12 tons per square inch, the forged mass itself would have a mean tensile elastic strength of only 7 tons per square inch, and correspondingly, if the faggot bar had a compressive elastic resistance of $21\frac{1}{2}$ tons, the forged mass itself would range under 18 tons per square inch.

Thus, within the limits of practice, the work of passive resistance sustainable by heavy forgings, was about one-half that of the faggot iron from which they were manufactured; but at the ultimate point of rupture, they gave a better result. Heavy forgings were also more trustworthy, when exposed to tensile strains in the direction of their length, or to transverse strains, as in girders, which ultimately were resolved into longitudinal strains, than when subjected to twisting strains, as in shafts, or to direct pull across the direction of length.

(To be continued.)

INSTITUTION OF ENGINEERS IN SCOTLAND.

At a meeting of this Society, on Wednesday, 16th March, Robert Stephenson, Esq., M.P., and Prof. R. Clausius (of Zurich), were unanimously elected honorary members.

Mr. Hunt, the secretary, in some remarks to the following effect, introduced for discussion the subject of

PATENT LAW REFORM.

It being generally expected that some change would shortly be made in the Patent Laws, it was desirable to discuss any amendments that were proposed. The amount of patent taxes contributed from this district entitled the contributors to a proper consideration by the Legislature of any suggestions they might offer; and by no other body in this locality could the matter be more appropriately taken up than by this Institution. At present a patent extending over the United Kingdom cost in taxes £175, if kept in force for fourteen years, £25 being paid in various sums on applying for the patent, and within the first six months, whilst £50 was paid at the end of the third year, and £100 at the end of the seventh year. As the last two payments were expected to be provided for out of the profits of the invention, and need not be paid if the patentee did not care to keep up the patent, it was usual to consider the cost of a patent as being £25 taxes, and in addition, the agent's charges for the preparation of documents, drawings, &c. The Manchester petitioners proposed to reduce the £25 tax to £15, and to substitute a tax of £25, payable at the end of the fifth year, for those now payable at the ends of the third and seventh years. At the last reduction of patent taxes in 1852, the annual crop of patents increased from 500 to 3,000, and a further increase might be expected if the taxes were again reduced.

Again, a provisional specification of the invention must be produced on applying for a patent. At that stage the document could not be expected to perfectly describe the invention, and yet it was required by law, expressly to prevent the patentee from afterwards adding to his patent any important improvements that might occur to him during its six months' progress to completion. And it might not be sufficiently explained in the provisional specification to afford ground for a valid claim in the final specification lodged at the end of the six months. This resulted in either the double expense of a second patent, or the making the claim wanted, at the risk of its invalidity being discovered. One of the greatest improvements introduced in 1852 was to make the patent date back to the day on which it was applied for. This was mentioned to show that there existed a precedent for making patents refer to dates prior to those on which they were in reality granted. It was suggested that with the view of remedying the evils referred to, any new patent act should contain clauses to the effect that:—1. Any publication of an invention by the inventor for, say, six months before the patent is applied for, should not invalidate it. 2. The actual use during that period by another party not authorised by the patentee should invalidate the patent. 3. The publication during that period of a description of the invention should not affect the patent, excepting in so far as it might bear upon the patentee's claim to be an original inventor.

This measure would certainly reduce the number of patents; but the cases in which it would cause the public to lose valuable inventions would be few or none. On the other hand, many of the valueless patents would be replaced by patents for valuable inventions, which did not get patented under the existing state of things. It was well known that many valuable inventions never had been patented, various circumstances having prevented their being patented, such as want of funds, and in a few months these inventions had proved themselves worthy of a better fate; but having been published, valid patents could not then be got for them. The writer believed there were more cases of this kind than was generally supposed. The proposed measure would extend protection to all future cases of the same kind. In considering in detail the Manchester suggestions as to the reduction of the taxes, it appeared they retained the £5 tax on the first application for a patent, taking the reduction entirely off the subsequent taxes. The first payment was, however, more felt than any, the value of the invention being then more uncertain than at any other time. There were also larger agency charges necessarily associated with it than those of the later taxes. Then, a common reason urged for reducing patent taxes, was to enable poor inventors to protect themselves, so as to render their inventions marketable. The £50 tax might be made payable at the end of the fifth year, and the £100 tax at the end of the ninth or tenth year.

The Secretary's remarks concluded with a few brief observations respecting the remainder of the Manchester proposals, which proposals are to the effect:— That the fund arising from patent taxes in excess of the expenses of the Government Patent Office be expended in promoting the progress of invention and science; that scientific commissioners be appointed to assist at the granting of patents; that a special court be provided to try patent cases; that a penalty be imposed on persons using the term "patented" without authority; and that some simple means be devised for extending British patents to the colonies.

After remarks from various members, it was resolved, that the Council of the Institution should consider the question, and call a special meeting, at which manufacturers and others interested should be invited to attend.

ROYAL INSTITUTION OF GREAT BRITAIN.

ON SCHÖNBEIN'S OZONE AND ANTOZONE.

By Professor FARADAY, D.C.L., F.R.S.

H.R.H. THE PRINCE CONSORT, K.G., D.C.L., F.R.S., Vice-Patron, in the Chair.

Friday, February 25, 1859.

OZONE has already been before the members of the Royal Institution on two occasions,—on the 13th June, 1851, when Schönbein's early views of it were given, and on the 10th June, 1853, when the results of MM. Frémy and E. Becquerel, obtained by passing the electric spark through dry oxygen, were described; and also the opinion of Schönbein respecting the entrance of ozone as such (and not as simple oxygen) into combination. Since then, Schönbein has been led to the belief that oxygen can exist in a third state, as far removed by its properties from ordinary oxygen in the one direction as ozone is in the other; and therefore, in a certain sense, antagonistic to ozone. This substance he names *antozone*, and believes that it also enters into combination, retaining, for the time, its special properties. Hence there is not merely ozone and antozone, but also ozonide and antozonide compounds. Thus, permanganic acid, chromic acid, peroxides of manganese, lead, cobalt, nickel, bismuth, silver, &c., form a list of bodies containing more or less of ozone in combination; and the characters of ozone, and of these bodies because of the ozone in them, is that they are electro-negative to the antozonides, *i.e.* as copper to zinc; they evolve chlorine from chlorides; they cannot generate peroxide of hydrogen; and they render blue the precipitated tincture of guaiacum. On the other hand, oxywater and the peroxides of potassium, sodium, barium, strontium, and calcium, form a list of substances containing antozone. These bodies are electro-positive to the former; they cannot evolve chlorine from hydrochloric acid, or the chlorides; they evolve the peroxide of hydrogen when treated either by oxy-acids or even the hydrochloric acid, and they not only do not render blue the white precipitated guaiacum, but they restore that which has been rendered blue by ozone to the white or colourless condition. Now when two ozonides or two antozonides are put together, with the addition of water or an indifferent acid, they mingle, but do not act on each other; but if one body from each list be associated in like manner, they mutually act, oxygen is evolved from both, and ordinary oxygen is set free; or rather, as Schönbein believes, ozone separates from one body, and antozone from the other; and these uniting produce the intermediate or neutral oxygen. Thénard, who discovered the peroxide of hydrogen, showed that the peroxide of silver, when brought into contact with it, not only caused the separation of part of the oxygen of the fluid, but also itself lost oxygen, that element leaving both bodies and appearing in the gaseous state. This experiment, with others of a like nature, and many new ones, were referred to and made in illustration of Schönbein's views. As to the independent existence of oxygen in these two new and antithetical states, ozone has been so obtained, *i.e.* out of combination, and independent of any other body; but antozone has not as yet afforded this proof of its possible separate condition. Oxywater is the compound in which it seems nearest to a free condition. As Schönbein's view includes the idea that oxygen in these two states can retain their peculiar properties when out of combination, and have them conferred otherwise than by combination, and as ozone does fulfil these conditions and does exist in the independent state, so it is important that antozone should be pursued by experiment until it gives a like result.

In relation to this subject the view of Mr. Brodie should be referred to, respecting the condition of certain elements at the *moment* of chemical change, on which he published a paper in the Phil. Trans. for 1850, p. 759, and another in the Chemical Society's Journal in 1855. He assumed oxygen as capable of existing in two states; the particles being polarized to each other by the action of associated particles, and for the moment in the relation of oxygen and hydrogen to each other; he also made many numerical experiments for the purpose of obtaining the equivalent action of the oxygens assumed to be in these opposed polar states.

LITERARY AND PHILOSOPHICAL SOCIETY, MANCHESTER.

March 8th, 1859.

W. FAIRBAIRN, F.R.S., &c., President, in the chair.

A CONVERSATION having taken place respecting Sir W. Armstrong's new gun, Mr. Roberts stated that he had, very many years ago, constructed a rifled cannon for the purpose of firing elongated shot coated with lead. Dr. Smith considered that the great merit of the new gun consisted in the manner in which the internal tube of steel was enveloped with wrought iron. The difficult problem of forming a perfect compound structure had received solution in the hands of Sir W. Armstrong, while others had failed.

Dr. Joule read an extract from a letter he had some time ago received from Professor W. Thomson:—"I have had an apparatus for atmospheric electricity put up on the roof of my lecture-room, and got a good trial of it yesterday, which proved most satisfactory. It consists of a hollow conductor, supported by a glass-rod attached to its own roof, with an internal atmosphere kept dry by sulphuric acid: the lower end of the glass-rod is attached to the top of an iron-bar, by which the hollow conductor is held about 2 ft. above the inclined roof of the building. A can, open at the top, slides up and down on the iron-bar, which passes through a hole in the centre of its bottom, and, being supported by a tube with pulleys, &c., below, can easily be raised or lowered at pleasure. A wire attached to the insulated conductor passes through a wide hole in the bottom of the can, and is held by a suitable insulated support inside the building, so that it may be led away to an electrometer below. To make an observation, the wire is connected with the earth while the can is up, and envelopes the conductor—its position when the instrument is not in use. The earth connection is then broken, and the can is drawn down about 18 in. Immediately the electrometer shows a large effect (from 5 to 15 degrees on my divided ring electrometer, in the state it chanced to be in, requiring more than 100 degrees of torsion to bring it back to zero, in the few observations I made). When the surface of the earth is, as usual when the sky is cloudless, negative, the electrometer shows positive electricity. But when a negative cloud (natural or of smoke) passes over, the indication is negative. The insulation is so good that the changes may be observed for a quarter of an hour or more, and when the can is put up the electrometer comes sensibly to zero again, showing scarcely any sensible change when the earth connection is made, before making a new start."

Dr. Joule stated, that he had recently witnessed experiments with Professor Thomson's new Atmospheric Electrometer, the merit of which consisted in its extreme sensitiveness, and the facility with which accurate observations could be made with it.

A Paper was read by Mr. Richard Roberts, M. Inst. C.E., entitled, PROPOSED IMPROVEMENTS IN PHAROLOGY.*

After adverting to the remarkable fact that the great majority of wrecks and collisions occurred in the immediate vicinity of the beacons intended to guard against them, Mr. Roberts mentioned, that amongst the numerous schemes propounded for the improvement of our present system of pharology, that of Mr. Herbert, of the Admiralty, who proposed to moor a series of floating lighthouses of great power of illumination, in a direct line up the centre of the English and other channels, appeared the most worthy of attention. He (Mr. Roberts) perfectly agreed with this suggestion, to which his attention had first been called by Mr. Murphy's Paper, read in section G of the British Association, recently held at Leeds, when it at once occurred to him that the principal of gyration might be advantageously employed to neutralize the action which the wind and waves exert upon floating light ships

After briefly describing the principal features of the catoptric and dioptric systems, Mr. Roberts stated that the latter was inapplicable to floating beacons, owing to their great oscillation, and that they were therefore still furnished with 12 in. reflectors, whose power was comparatively small. He felt convinced, however, that the more fully the system of Mons. Fresnel became understood, the more certainly would it be preferred to the catoptric system, over which it possessed, among other advantages, that of producing about four times the amount of light as the effect of the combustion of the same quantity of oil.

It was, however, essential to the adoption of this system, that the light apparatus be kept upright and free from oscillation, to attain which desideratum Mr. Roberts proposed entirely to change the form of the vessel, making that portion of it which was immersed hemispherical, and that which was above water the frustum of an inverted cone, as he thought that this form would present less resistance to the wind and waves, where these were expected to act from every point. In certain situations, however, a double pointed vessel might be advantageously used.

In the centre of this float, Mr. Roberts proposed to build a tower (whose lower end should project through the bottom of the float to serve as a keel), carrying a lantern as in shore lighthouses, and containing the necessary accommodation for the light keepers, &c., and within this lantern he proposed to place a dioptric apparatus of the second power, whose light being placed 45 ft. above the water line might be seen at a distance of 9 miles. Immediately below the light apparatus, he would place a fly-wheel, suitably mounted on gimbals, and driven through the medium of certain wheels and shafts by a small engine, which, with its boilers, would be placed on the third deck of the float, or this wheel might be caused to revolve at its proper speed by two relays, each of three men. The engines and steam might be used for a variety of purposes, as to sound bells or whistles, hoist coals aboard, prevent the adhesion of snow to the lantern, &c.

Mr. Roberts proposed to moor the float by three anchors, to each of which he would attach two heavy cables, passing through hawse pipes 120 degrees from each other; the tension on these he would regulate by a suitable windlass, and he fully believed that by this system of mooring the float (which together with the tower he would construct of iron), and by causing the dioptric apparatus to rotate about 100 times per minute, the desired object would be attained.

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* A more minute description of Mr. Roberts' proposition is given at Page 100, and a Plate illustrating it (No. 145) will also be found in the present number.—[ED. ARTIZAN.]

CORRESPONDENCE.

[*We do not hold ourselves responsible for the opinions of our Correspondents.*—ED.]

FLOATING LIGHTHOUSES.

(Illustrated by Plate No. 145.)

To the Editor of The Artizan.

SIR,—A short time ago I noticed in the columns of a contemporary an animated discussion relative to Mons. Leon Foucault's interesting discovery—the gyroscope. These letters, however, treated only of its principle, and so far as I have been able to learn, the only practical application of it hitherto has been Prof. Piazzi Smith's adaptation to telescopic purposes at sea. I think, however, that this principle will hereafter be found of great practical utility, and will, with your permission, point out another instance in which it may be profitably employed—viz., to neutralise the violent action of the wind and waves upon floating lights.

That the present system of pharology needs great improvement, the well-authenticated fact that a large majority of wrecks and collisions occur in the immediate vicinity of the beacons intended to guard against them, affords ample proof. Accordingly, of late, many schemes, of more or less merit, have been propounded to obviate these dangers, amongst which the proposal which originated with Mr. Herbert, of the Admiralty, to substitute for the present shore lighthouses a series of floating "lights," placed along the middle of the British, Irish, and other channels, so that ships might be guided on their way without departing from their direct course, without the necessity of calculation, and without approaching the dangers of the shore or risk of collision,—is, perhaps, the best, and with it I cordially agree. It is, however, foreign to my purpose to discuss this point, or even to enlarge upon the demerits of the present system, whether of shore or floating lights. Suffice it to say that the greatest objection to the latter is, that whilst at present the violent oscillation to which they are subject in rough weather renders all arrangement of glasses for the dispersion of light in a zone inapplicable to them, and without such aid they cannot be seen from a distance, except in dark clear weather (and even then their range is very limited), and that they are often mistaken for the lights carried by large steamers. My attention was first called to this fact at a meeting of the British Association, recently held at Leeds, when a paper on the subject was read by Mr. Murphy, and I at once conceived the idea of turning to account the principle of gyration, and have embodied my ideas in the accompanying drawing, in which all details are purposely omitted to avoid confusion.

Description of Plate No. 145.—A A, body of the float, the immersed portion of which is hemispherical, and that portion which is above water the frustum of an inverted cone. This form of float will, I think, present less resistance than any other to the action of the wind and waves where these are expected to act from every point of the compass. It may, however, be advisable in certain situations, as currents, tideways, &c., to employ a vessel pointed at both ends. B B, a cylindrical tube, the lower end of which projects through the bottom of the float and forms a hollow keel for the reception of ballast, that portion of the tube which is above the deck serving as a tower upon which the light is mounted. The object of the keel is, of course, to lower the centre of gravity. C C, the lantern. D D, gallery surrounding the lantern. E E, dioptric light apparatus (Fresnel's system) of the second order, the lamp in which is shown 45 ft. above the water. F F, fly-wheel or gyrator mounted on gimbals (which are placed a little above the centre of gravity of light apparatus and fly-wheel taken together) on the upper end of the shaft G. This shaft receives motion through the wheels H, I, and J, from the shaft K K, which is driven by a pair of small steam-engines (or one of them), as indicated at L, Fig. 3, on the third deck; or the fly-wheel may be kept in motion at its proper speed by two relays, each of three men. M M, small high-pressure steam-boilers for working the engines, which, in addition to turning the fly-wheel, may be employed to pump water, hoist coal, &c. Steam might be advantageously used to keep the light-room sufficiently warm to prevent the adhesion of snow to the exterior of the windows, to warm the barrack-rooms, and to sound one or more whistles. The engine may also be made to ring bells, &c. *n*, casing surrounding the fly-wheel; *o*, bridge-piece bolted to the fly-wheel, concentric with which it carries a stud upon which is the plate that maintains in its place the light apparatus, whose weight is borne by a number of rollers which are carried round with the fly-wheel. *p*, flame of the lamp, the pump of which is to be worked by the shaft K; *q*, glass chimney; *q* 1, metal tube fixed to the frame which carries the lenses; *q* 2, a telescopic tube, the lower end of which is carried by gimbals at the top of the frame carrying the lenses. The upper end of this tube is supported by gimbals in the top of the dome, and works freely in the exit tube *q* 3; R and R I, pair of cables attached to one of the three anchors by which the vessel is moored. I propose that this lighthouse be moored by three anchors, and that to each of these, two heavy cables be attached, which shall pass through hawse pipes in the side of the float, situate 120° from each, as shown in the plan of the first deck. I also propose to fix upon this deck a suitable windlass, so adapted as to give the requisite tension to all six chains, two pairs of which are to arrive at the centre of the tower at the level of S, and the third pair at that of T. By this method of mooring, the vessel will be always kept over a particular spot, and the cables will surge less; consequently there will be less risk of the anchors dragging, whilst from whatever quarter the strain may come, the resistance will be about the same. The central portion of the first deck is raised above the outer portion, to prevent water flowing on to it, and thence between decks.

Having thus briefly described my proposed improvement, permit me to say that I think that by the gyrations (about 100 per minute) of the fly-wheel, together with the peculiar form of float which I employ and manner in which I moor it, the desired object will be obtained,—that is, the amount of oscillation reduced to a minimum, so that, by the use of a dioptric apparatus, the intensity of the light may be increased upwards of 300-fold, whilst the height of the tower will greatly increase the range of the light. It may be objected that the employment of steam-engines would entail serious expense. This, however, would not be the case, as their maintenance would not exceed £150 per annum, even if no corresponding reduction were made in the number of hands employed. I may add that the weight of this floating lighthouse, with machinery, coals, &c., on board, would be about, exclusive of ballast, 300 tons, whilst the displacement of the float is equal to about 600 tons: it may therefore be practicable to add to the height of the tower. The light apparatus which I propose to employ is to remain stationary, but the character of the light may be varied by causing a suitable screen to revolve around it, motion being imparted from the main shaft.

Your obedient servant,

RICHARD ROBERTS.

LIST OF NEW BOOKS AND NEW EDITIONS OF BOOKS.

KING (E. T.)—Ten Thousand Wonderful Things; comprising Odds and Ends of Things Curious and Extraordinary in Art, Nature, and Science (Illustrated), pp. 330, cloth, 3s. 6d. (Ward and Lock.)

SILVESTRE (T.)—Arts, Artists, and Industry in England. 8vo, 2s. 6d. (Bradbury.)

SMITH (J.)—The Problem of Squaring the Circle Solved; or, the True Circumference and Area of the Circle Discovered. 8vo, 1s. (Longman.)

ROGERS (H. D.)—The Geology of Pennsylvania: A Government Survey; with a general View of the Geology of the United States, Essays on the Coal Formation and its Fossils, with Description of the Coal Fields of North America and Great Britain. 3 vols., 4to, pp. 1,600, and vol. of Maps, cloth, £8 8s. (Blackwood.)

NOTICES TO CORRESPONDENTS.

J. A. C. (Chelmsford).—As to your first inquiry, our reply is—No successful employment of electro-magnetism as a motive power, on a large scale, has been made. As to the second—Weale, Griffin, and Walton and Maberley have each published works which treat of the subject; apply to them for catalogues. As to the third—the economy of employing certain elements depends upon the nature or purpose of the experiment, and the *character* of the force required. As to the fourth—Professor Page attained a considerable degree of experimental success, but *practically* his experiments were unsuccessful. These answers are all you require in reply to your queries, but if any further information should be needed, write at length, with your address appended, and we will reply through the post.

J. A. C. (Paris).—The following is the test which we think you refer to; it was made at the Mersey Forge, Liverpool, at the end of February, or early in March, this year. The piece of puddled steel was 4 ft. long, and in section 1 in. × $\frac{3}{16}$ in.; it was loaded with a dead weight of 8 tons 10 cwt. (= 45·33 tons per sq. in.) at 4 p.m.; at 9 p.m. (5 hours) it had elongated 15-20ths of an in., the weight was then removed, and the length of the bar when measured was found to be 4 ft. $\frac{13}{20}$ of an in., showing a permanent set or elongation of 13-20ths of an in. The same weight was again applied, and remained on until 4·15 a.m., when it was found to be 4 ft. $1\frac{1}{5}$ in., and upon removing the weight the permanent set was found to be exactly 1 in. A weight of 9 tons 10 cwt. (= 50·66 tons per sq. in.) was then gradually applied, when the elongation was found to be $1\frac{17}{20}$ in., and further weight was added, making together 10 tons 5 cwt., when the bar broke, thus giving an ultimate result of 54·66 tons per sq. in. It is worthy of mention, that in some experiments we were employed to make for an eminent wire drawer's firm in Birmingham, some pieces of cast-steel wire bore strains varying from 110 to 118 tons per sq. in.; these experiments were very carefully made.

W. L. (Rochdale) had better remit 12s. to Mr. J. Simpson, the publisher of THE ARTIZAN, payable at Charing-cross Post-office, whereupon he will receive Plate No. 120. It is not at all likely that W.L.'s request will be complied with, unless he furnishes the publisher with his name and correct address.

J. W. C. (Hotwells).—We have had similar inquiries from South Wales.

T. Y.—You are in error. Our objection to the measured mile test is, not that it is absolutely unfair, all steam-ships being tested in like manner, but that unless the engine-room and stoke-hole be watched most carefully—nay, suspiciously—and in a spirit adverse to the contractor, the best results are likely to be obtained by the best *jockey*, rather than the honest economic maximum result, which may at any other time be attainable with the same recorded (or assumed) expenditure of coal and water. We say the distance is *too short*, and a run of 50 miles, whilst it is but little more expense, would be practically of inestimably greater value, as being a much more reliable index of the actual performance ability, and economy under ordinary circumstances. Had runs of 50 miles been adopted by the Admiralty instead of a single mile (or knot) as a test for the machinery, what every practical man who paid any attention to the subject long since discovered, but which the Admiralty, until recently, was profoundly ignorant of, would have been demonstrated to some extent, namely the want of *boiler power* in Her Majesty's ships; at least it would have awakened, many years sooner, attention to the subject.

Don J. de R. (Madrid).—D. K. Clark's plan of burning coal, instead of coke, and preventing smoke in locomotive boilers is an excellent plan, and we hear from eminent locomotive engineers it answers admirably.

J. B. K. (Glasgow).—Mr. G. W. Jaffrey, of Hartlepool, was the party we referred to, he informed us of the success of a description of furnace door applied by him on board of several screw steamers, by which the temperature in the stoke hole was maintained so low as to be perfectly comfortable; but it is nearly two years since we have heard anything of the matter.

J. (Sheffield).—You have several very excellent practical chemists and analysists in your neighbourhood. There used to be a Mr. Julian Slater, of Sheffield. If he is not now alive or resident in Sheffield, we advise you to apply to Mr. T. W. Keates, F.C.S., No. 14, Chatham-place, who is, in our opinion, the best practical analysist of such articles in London.

R. T. SEVESTRE (Chowringhee-lane, Calcutta).—Write again to us, and more at length.

W. T. (Lambeth).—We have read your letter attentively, and consider you are not altogether wrong; but we should very much like to take your opinion upon the subject after you had filled the post of editor for a few months; we *rather* think, "the right thing would *not* be found in the right place," even then; still, we are obliged for the reminder.

R. B. (Folkestone).—Have you had plate No. 65?

P. (Bilboa).—The Rhine Oak, respecting which you inquire, is sold as follows:—Oak trees, per cubic ft., to 36 ft. long, 4s. 6d.; to 42 ft., 4s. 9d.; 48 ft., 5s. All above, 5s. 6d. per cubic foot; smaller trees, 3s. 6d. to 4s. per cubic foot. All these are Queen's caliper measurements. These prices are for freight and duty paid, delivered in the Thames. 2nd. On the Upper Rhine, where this oak is grown, it is always cut down from about the middle of November to the end of February. These answers are all you require.

E. H. (a subscriber)—If you refer to THE ARTIZAN for several years past, you will find most of the dimensions and particulars you inquire for. Pray take a little trouble. When the dimensions of any of the ships you name are not given in THE ARTIZAN, we cannot do better than refer you to the builders and engineers who have constructed the ships and their machinery. As to your second inquiry, some standard must be assumed for calculations, so the 7½ lbs. was, in many cases, adopted, irrespective of the slight variations in boiler pressure.

C. E. F. (Lambeth)—Particulars respecting Muntz's yellow metal will be sent by post.

ADMIRAL PARIS' work, noticed in THE ARTIZAN for February and March last. We allowed an error to pass uncorrected, as to the name of the talented Director of the Messageries Imperiales, which should have been M. Behie, *not* Baker.

R. S. B., J. C., P. R., and J. Smith, must stand over.

A. S., R. P. D., P. Thompson, and others, whose addresess we have, will be replied to by post.

Numerous letters and communications on various subjects must stand over until next month.

Various Reviews and Notices of New Books are, at the last moment, unavoidably obliged to be omitted.

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c.

UNDER this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.—ED.

LOOMS—WEAR AND TEAR.—At the Northern Spring Circuit, Lancaster (18 Feb. ult.), an action for alleged breach of covenant in a lease for seven years of a loom, shed, and machinery, in Blackburn, was tried—the allegation being, that the defendants had not delivered up the loom, machinery, &c., at the expiration of their term in as good a state and condition as they were in at the time of taking possession, *fair use, wear and tear excepted.* A claim of £233 13s. 6d. had consequently been made by plaintiffs as the estimated cost necessary to restore the machinery to its former condition, after allowing for fair wear and tear. Defendants had paid £23 13s. 6d. into Court, as amply sufficient for required reparations. Conflicting evidence on both sides, as to the value of the machinery at commencement and end of the seven years' term, was produced. The average period that a loom would last was stated to be about fifteen to twenty years; and that the customary allowance for wear and tear was 7½ per cent. per annum. (Plaintiffs' evidence said 5 per cent.) The jury found a verdict for defendants.

RAILWAY ACCIDENTS—EXAGGERATED CLAIMS.—In a recent action for railway compensation (Phillips and wife *v.* the London and North-Western Railway Company, Court of Queen's Bench), for alleged injuries received from an accident on defendants' line, at Watford, 22nd March, 1858, when the carriages ran off the line, the jury found a verdict for the defendants (the railway company).—Lord Campbell, after verdict given, remarking that he thought this was a case in which the plaintiffs had sought to impose on the company.

RAILWAY CURVES, COUPLING-PINS, SLEEPERS, &c.—At the adjourned inquest respecting the late fatal railway accident at Leamington, the following verdict was returned:—"The jury are of opinion that the deceased met with his death from an accident on the railway, caused by the breakage of the adjusting screw of the leading or near spring of the engine attached to the 10·5 train from Rugby; but that there is no evidence to show how the breakage occurred. The jury recommend that the rails of all curves, such as the one where the accident happened, should be more strongly pinned or coupled together, and stronger timber used for sleepers."

THE STRIKE AGAINST SEWING MACHINES has given rise to much ill-feeling, and even to the perpetration of acts of violence and outrage. At the late Oxford Circuit Assizes, held at Stafford, 17th March, ult., a shoemaker, a non-unionist, was tried on the charge of maliciously shooting, with intent, &c. It appeared in evidence, that for some time past a strike against the introduction of sewing machines has existed amongst the working shoemakers at Stafford, as elsewhere. The prosecutor was one of the men out on such strike, whilst the accused was one of those who, refusing to join in the opposition, were in consequence, exposed to great annoyance. The imputed felonious shooting had arisen out of one of these attempts at intimidation. The jury returned a verdict of acquittal.

ALLEGED RAILWAY RACING.—In the Court of Common Pleas (24th February ult.), an action (Halsey *v.* London and South-Western Railway Company) was tried, in which the plaintiff, a widow, sued the company, under Lord Campbell's Act, for loss sustained by the death of her husband, alleged to have been caused by the carelessness of defendant's servants at Bishopstoke Station, on the 20th June ult. On that day an excursion train from Portsmouth to London entered the station at a reckless speed. A quantity of gravel had been left to accumulate about the rails, having been placed there from time to time to enable the wheels of the trains to "bite," and the gravel at last reached the level of the rails. Another train (the Portsmouth and Southampton) was also nearing the Basingstoke Station at the time; and several witnesses deposed that the two trains were racing against each other to reach the station first; and that the speed was 45 [others said 50] miles an hour. Carriage in which deceased rode was thrown off the line, and he was killed. Defence that the trains were going at a moderate speed. Verdict for the plaintiff—damages, £750.

PATENT LAW.—JURY IN EQUITY COURTS.—In Vice-Chancellor Wood's [Equity] Court (2nd March ult.), in a case of alleged infringement of patent, it had been urged that this was a case in which the question might better be tried by a jury in this court than by the ordinary trial at law. The Vice-Chancellor said, it did not appear that this was a case contemplated by the recent Chancery Amendment Act [providing, *inter alia*, for Juries in Equity Courts]. That Act provided for the sitting of a jury in Chancery when "*in any suit*" a question of fact was raised. Now, the section in these patent cases was not an action to try a question of fact raised "in a suit," but an action to determine the legal right, and to such an action the suit was merely ancillary. The trial would, therefore, take place at law.

ARTIFICIAL MANURE FACTORIES.—On the Oxford Circuit, Civil Court, 5th March ult., an action was tried for the removal of a nuisance, caused by an artificial manure manufactured near the plaintiff's premises, at Goring, in the county of Oxford. Plaintiff had recently built a house on the banks of the Thames, at Goring, at a cost of £2,000, and expended £1,000 in furnishing it. Subsequently he found his health seriously affected by the stench arising from the neighbouring works of the defendant. After several scientific witnesses had been examined, the judge suggested an amicable settlement. Ultimately defendant agreed to purchase plaintiff's benefit in the lease of the property (20 years unexpired) for £900, and also the furniture.

RAILWAY LIABILITY TO WORKMEN FOR DAMAGES.—In a recent case heard in the Court of Queen's Bench (Hodgson *v.* North Eastern Railway Company), plaintiff, a bricklayer and plasterer, in the employ of the Hull Dock Company, recovered £85 damages, in addition to £15 which he had received from defendants, for injuries received by him while engaged in pointing an arch over defendants' railway at Hull, when some trucks came along and broke down the scaffolding on which he and several other workmen were standing.

TRADE MARKS—COTTON THREAD.—In the Vice-Chancellor's Court, the proprietor of the well-known "Taylor's Persian Thread," applied (23rd March ult.) for an injunction to restrain a firm at Manchester from infringing plaintiff's trade-mark. The thread in question is wound upon reels by machinery—labels or marks being affixed at both ends of the reel, one denoting the quality of the thread, the other denoting (or purporting to denote) the number of yards on the particular reel. By the pleadings, some extraordinary disclosures were elicited as to the practice prevailing in the thread and cotton trade of winding "short lengths" on the reels or "spools," and marking them as long lengths, or as containing a greater number of yards than are actually wound on them. The thread, as plaintiff alleged, "was wound by means of machinery so constructed as to ascertain the lengths of the thread wound upon reels; and whenever the quantity in yards is stated on the labels, the same has always stated and states the true quantity." It appeared, however, on the evidence, that the plaintiff's firm had been in the habit of supplying "certain firms and persons, *at their special order*, reels marked as containing 'long lengths,' when they in fact contained 'short lengths'" (as for instance, reels containing only 230 yards of cotton thread, although marked with the number 300). The Vice-Chancellor, after some remarks condemnatory of the practice, said, "It was clear the Court could not interfere in such a case by injunction. If the plaintiff said he had acquired a name in this trade, and if the Court found the public had been deceived in the article by the plaintiff's own misrepresentation, the Court certainly would not assist him to continue the deceit. The bill must therefore be dismissed with costs." Injunction refused accordingly.

GROUNDING OF THE STEAM-SLOOP "ARDENT."—The court-martial assembled on board the *Formidable*, at Sheerness (23rd March ult.), to try the commander and master for allowing the paddle-wheel steam-sloop in question to run on shore (24th December last) on the West Coast of Africa—sentenced them to be reprimanded, and admonished to be more careful for the future.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

WE have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "18, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

THE TRADE AND NAVIGATION RETURNS, for the month ending January 31st, show that the total declared value of exports from the United Kingdom for the month was £9,593,423, against £7,221,600 for corresponding month in 1858, showing an increase of £2,371,823. The increase is perceptible in cotton manufacture, earthenware, hardware and cutlery, linen manufactures, linen yarn, silk manufactures, thrown silk, woollen and worsted yarn. Decrease in leather, machinery, railway-iron, and some other articles of export.

SHOEMAKERS' STRIKE.—MACHINE *v.* HAND.—The old grudge and rivalry between machinery and hand-labour, so invariably, in every branch of manufacture, found to be decided, ultimately, in favour of the former, and to be beneficial even to its very bitterest opponents themselves, have recently been revived in Stafford, where the operatives, following the example of Northampton, are now "on strike." The published determination of the manufacturers to give out *machine-sewn* boot-tops for their workpeople (1st March ult.) led to this decisive step on the part of the men. As soon as the announcement became known, the different trade societies adopted resolutions similar to those passed at Northampton—viz., to "strike" the shops of all the manufacturers who had signed the circular. Several hundreds of the shoemaking operatives have already left the town on strike, as in the recent case of the Northampton men, because they would not work up machine-sewn tops. The "binders" are also on the move.

BLEACHING AND DYEING WORKS.—In the House of Commons (24th February ult.), a motion (by Mr. Cook) for leave to bring in a Bill to place the employment of women, young persons, and children, in bleaching and dyeing works, under the regulations of the Factory Act, was negatived on a division of 108 to 30.

WAGES OF DOCKYARD ARTIFICERS.—In the Navy Estimates for this year, the proposed item is £966,921; in 1852-3 it was £666,929—being an increase of 45 per cent. This large increase is officially stated to have been caused by the increase of steam factories in our dockyards, arising entirely from the increased adoption of steam-power in our Navy during the last few years.

COMBINATION OF WORKMEN.—Mr. Drummond gave notice (3rd March ult.) to introduce a Bill to amend and explain the Act of 6th George IV., to repeal the laws relating to the combination of workmen, and to make other provisions in lieu thereof.

EAST INDIA.—PUBLIC WORKS, CANALS, RAILWAYS, BRIDGES, &c.—In the House of Commons (3rd March ult.) Mr. Hadfield gave notice of moving for an Address for return of all public works of a remunerative nature, such as canals, railways, works of irrigation, roads, and bridges in India, for the last ten years; and distinguishing such as are complete, from those in progress.

THE LONDON MECHANICS' INSTITUTION (Dr. Birkbeck's) is, apparently, fast recovering from its downward progress. The efforts made to raise the sum of £1,500 for the purchase of the lease of the original premises in Southampton-buildings, have been successful. It is now intended to go on and raise the £3,500, in order to clear off the debt of the institution. At the last Quarterly Meeting, W. F. Birkbeck, Esq., the President, was in the chair. The Report submitted was of a cheering and encouraging character.

THE GLASS TRADE "LOCK-OUT" still continues. At a recent meeting of the operative flint glass makers, at Newcastle, it has been resolved to support the "locked-out" glass makers throughout the country.

PUMPING-ENGINES AND MACHINERY FOR RAISING THE [MAIN DRAINAGE] SEWAGE AT THE DEPTFORD STATION.—The Committee have, in their recent Report, recommended that Messrs. Stephenson, Bidder, Field, Hawkesley, and Penn, be requested, in conjunction with the Engineer of the Board, to give their opinion on the relative merits of the designs and tenders sent in (pursuant to a resolution of the Board of the 11th Feb., 1859), as applicable to the works to be carried out.

THE BLIND ARTIZANS OF LONDON.—A small brush, mat, and basket shop, in the Euston-road, not far east of St. Pancras church, serves as the repository of the productions of blind men and women. The "town-traveller" for orders through the wide metropolis is a blind young man; so also is the shop-porter. Blind persons of both sexes, shiftless and poor, are taught profitable trades in little workrooms behind and above the shop. The superintendent (an active and most intelligent one), himself blind, directs the enterprise. In the library is a good selection of books for the blind on every system, and accessible to blind persons, as a free lending library, or at the smallest possible cost where it can be afforded.

COLONIAL AND FOREIGN WOOD.—In the House of Commons (3rd March ult.) Mr. Mitchell gave notice of his intention to move a resolution to repeal the duties on foreign and colonial wood.

HORSESHOES FORGED BY MACHINERY.—A machine for this purpose, recently patented in this country, by the inventor, Mr. Henry Burden, of Troy, in the State of New York, has been erected at Chillington Ironworks, Wolverhampton. The present machine, patented in 1857, differs materially from those previously (viz.. in 1835 and 1843,) patented by the same inventor. The bar, after being heated, enters the machine by a feeding apparatus; a piece of the required length is cut off, and, by a stroke from a piece of steel, shaped like the inside of a horseshoe, is bent, and falls upon a die on a wheel beneath, corresponding to one on a cylinder above, and thus acquires, by pressure, the required shape, two lateral strikers, at the same moment, hitting the extremities or heels of the shoe, and driving them inwards into the required shape. Thence it passes between another pair of dies, where it is stamped, and flattened from the curled shape which the wheel gives it as it falls at the mouth of the machine. The shoes thus made are described as remarkable for their exactness in shape, and in the position of the holes—a point important with regard to the safety of horses' feet. They can be produced at the rate of sixty per minute, which is more than two men can forge in a day. As the bar is bent before being pressed in the die, the pressure at the crown is in the direction of the width, and hence the widening is readily effected. The United States Government, it seems, purchase the shoes thus made (the process is patented in America) for the supply of the cavalry of the States.

THE NEW "LILLOOET ROUTE" [interior of New Caledonia] is in rapid course of construction, and is expected to be fully available next summer. The Home Government has sent out a corps of Sappers and Miners to lend efficient aid in the formation of this route, so important to the new colony, as obviating the dangers of the rapids, and removing the delays of the Fraser River route, from the mouth of Harrison River up to the Forks, and opening up the much desired line of communication with the (now undoubtedly proved) rich Upper Fraser River country, at and about the Forks of the Fraser and Thompson Bridge River, and the country bordering on New Caledonia, far up in the interior.

FRAUDULENT TRADE MARKS.—Official intimation from the Foreign Office has been addressed (14th February ult.) to the Council of the Birmingham Chamber of Commerce, that the subject of taking steps for "the protection of British trade-marks in all countries" ("fraudulent imitation of the trade-marks of British manufacturers in foreign coutries") is under the consideration of Her Majesty's Government.

STEAM HAMMERS.—A very large one has just been made at the works of Messrs. Morrison and Co., of Newcastle (upon Morrison's patent principle), for the Mersey Steel and Forge Company, Liverpool. Total height, 21 ft.; width between frames, 14 ft. 6 in.; clear height from the ground to underside of frame, 9 ft. 4 in.; hammer-bar, 15 in. diameter and 19 ft. long, of steel, with the piston, which is 36 in. in diameter, forged in one solid piece, the hammer-bar forming a solid mass of steel, weighing above 7 tons in the finished state, with a stroke, or clear fall, of 6 ft.; cylinder, 36 in. in diameter, and weighs above 8 tons; weight of the two frames, 15 tons. The hammer, when in its place, will stand upon a mass of cast iron, wood, and stone, 32 ft. long, 18 ft. wide, and 9 ft. deep. Intended for preparing for steel (on Clay's patent process) for being rolled into plates for shipbuilding, &c.

A SMALLER [3-TON] DITTO is also being constructed by same firm, for Messrs. W. G. Armstrong and Co., for the manufacture of Mr. Armstrong's wrought-iron rifle-guns.

EXHIBITION OF PATENTED INVENTIONS. The last day for receiving models, specimens, or drawings, for the Society of Arts' Annual Exhibition of Inventions is the 9th of April instant.

POCKET CHESS AND DRAUGHTS.—A simple combination of these games has been submitted to us. It consists of a flat box, 4 in. square, containing a folding pasteboard with black and white squares; also flat chessmen, stamped in gold on dark purple and white ground, the reverse of which form draughts. The whole goes easily in the pocket, and will be sent post-free for seven stamps, by Mr. S. B. Beal, 4, Grove-terrace, West Ham, Essex, E.

A NEW WASHING MACHINE has been introduced into France. It is composed of a board, pierced with several contiguous rows of holes, into which flat-headed wooden pegs of hard, polished wood (*champignons en bois*), called "rubbers" (and the heads of which come nearly into contact one with the other), are inserted, and move freely. This board being fixed a little below the level of the water, the flat nut-headed pegs rise up in the holes, and their heads float upon the surface, in which position they are kept (*i.e.* vertical) by the holes in the plank. Another, similar, board, but in which the champignon-headed pegs or knobs are fixed in the boles, is inverted above the former one, in such manner that all the knobs on either board are brought into contact. A rack-and-pinion slide, put in motion by a handle, is fixed on the second board, which it causes to travel to and fro on the first; and the whole is enclosed in a vat containing soap and water, or water alone. The linen, &c., to be washed is placed between the two boards, where, by the action of the lower set of "rubbers" on those floating above, it is beaten and rubbed effectually, so as, in a very short time, to cleanse it from all impurities.

THE SEAMLESS LEATHER [LIMITED] COMPANY'S creditors have been required to prove their claims before the Commissioner in Bankruptcy.

WORKMEN'S STRIKES.—At Glasgow, both the PLUMBERS and BOTTLEMAKERS are on strike: the former have been so for about three months past; and the latter, for nearly the half of that period. The sheriff has issued a proclamation warning the men against resorting to acts of intimidation.

BRAY'S TRACTION ENGINE, drawing a truck loaded with 25 tons of iron, traversed, 9th March ult., the York-road, rounding with comparative ease the sharp turn from the Belvedere-road into the wharf of Messrs. Maudslay and Co.

THE LIFE-BOAT RECENTLY PRESENTED TO THE PORT OF CALAIS by the Royal National Life-boat Institution, has, we regret to say, made but an inauspicious commencement of its intended career of usefulness. In the attempt to rescue the crew of the mail-steamer *Prince Frederick William* (to the disaster that befel which we have elsewhere alluded), a wave drove the life-boat with great violence against the steamer, which pitched at the time; the boat turned slowly over, and all on board were thrown into the sea. Several held on to the lashings of the boat, which, through that circumstance, righted, but one after the other they were washed away by the waves. Many of them got safely to shore, it being fortunately nearly dead low water at the time. Three, however, were drowned. On the one hand, the disaster is attributed to the heedless rush of the steamer's people into the life-boat, and consequent overcrowding of the same; whilst other accounts ascribe the catastrophe to the fact of the life-boat being allowed to receive the passengers on the windward instead of the leeward side of the vessel.

FOREIGN TIMBER.—Quantity imported last year, 1,100,000 tons; consumption (since 1843) has increased 454,000 tons. Colonial ditto, 1,095,000 tons; consumption (since 1843) has fallen off by 186,000 tons. *Total duties on foreign and colonial wood* in 1858, £564,009.

THE EXTENSIVE ROPE MANUFACTORY of Messrs. Smith and Co., in New Church-street, Bermondsey, was (9th March ult.) destroyed by fire, which commenced late at night in one of the buildings containing a great quantity of hemp, jute, and other inflammable articles. A great amount of property destroyed, including one building 50 ft. long by 45ft. wide; the wheel sheds, hemp and jute lofts, and the tar sheds. On this occasion, the two powerful steam floating engines were brought to play on the burning mass, in conjunction with the seven land engines of the London Brigade.

BOUNDARY SURVEYING.—The Government, in conjunction with France and Turkey, and in accordance with the provisions of the Paris Congress, guaranteeing the integrity of the Turkish territory, have announced their intention to dispatch a staff of engineer-officers to Montenegro to make a survey of the boundary line of that country, as regards a proper division between it and Constantinople.

THE GREAT CLOCK AND BELLS AT WESTMINSTER are still incomplete, so far at least as horological uses are concerned. The true reason for the delay in completion has not yet transpired.

THE MECHANISM by which the great bell and its four companions are hung in the bell-chamber, is simple, but apparently well adapted to its purpose. A massive collar wrought-iron boiler-plate goes round the chamber, about 14ft. from the floor, and 2 ft. from the side walls. This is supported by twelve cast-iron standards, two at each corner, and a main beam in each side of the tower, and each of these, resting in the masonry of the walls, leans out at an inclination of about 15 degrees, to meet and support the collar. Pads of vulcanised india-rubber, between the collar and the standards, check vibration to a certain extent; while iron rollers at the base of the standards themselves allow the whole frame to play freely. In order to prevent the great weight on the standards thrusting the walls outwards, the ends of all are firmly bound together crosswise, with wrought-iron tie-rods of great strength. Crossing the collar at right angles, and firmly bolted to it, are two massive wrought-iron beams, one of which has been tested to 75 tons weight, and only deflected the fifth of an inch. To this the great bell is bolted, and is, consequently, as rigid as the tower itself—a manner of fixing it which is, we believe, universally, amongst practical judges, considered to be not only injudicious but even injurious, both to the tone of the bell and the stability of its supports. This defect in the original plan of hanging has been since partially remedied by bolting in wrought-iron brackets between the collar and the standards, so as to bind the whole together, and reduce the vibration. The clock-room has been ready for the reception of the clock since last Christmas; but still, to the great and pretty loudly-expressed disappointment of the public, the clock is not there.

WOOL FROM CAPE COLONY.—At a recent meeting of the Society of Arts, the rapid increase in the quantity of wool produced in this colony was the subject of remark, namely, from 113,000 lbs. in 1833, to 18 million lbs. in 1858; proving the suitability of the climate to the rearing of sheep.

FORCE OF WINDS—NAUTICAL SCALE.—A "strong gale" is only the ninth degree of strength; a "calm" being zero, and a "hurricane" twelve; a "strong breeze" is a wind occupying the sixth place on the list.

WRECKS OF THE UNITED KINGDOM.—From the returns made, 10th March ult., to the Committee of Privy Council for Trade, by the Surveyor-general, it appears, that in 1858, 1,895 lives were imperilled, and of these, only 18 per cent. were lost, against (in 1857), 2,200 lives imperilled, and 24·2 per cent. lost. Of the 1,555 lives which were saved during the year 1858, 206 were saved by LIFE-BOATS, 210 by ROCKET AND MORTAR APPARATUS, and the remainder, with the exception of 26 lives (saved by meritorious individual exertion) were rescued by ships, steamers, small craft, and coast-guard boats, and amount to 1,113. The four winter months are those in which the greatest number of wrecks have generally occurred each year: in June (generally) fewest wrecks. Total wrecks and casualties, in or near the coast of the United Kingdom, in 1858, 1,170; of these, 957 were to British, and 209 to foreign ships: 47 of the British ships were steamers, 37 coasters, and 10 over-sea steam-ships. 337 of the wrecks were colliers, 151 to vessels in ballast, 110 to vessels carrying a general cargo, and 101 grain-ships. Smallest number of wrecks in any one class was 7, the cargo of the vessels being cotton. Greatest number, by far, of the wrecks both in 1858 and other years, occurred on the east coast, Dungeness to Pentland included—514 happening along these shores. The west coast (Land's End to Greenock) was the next most fatal,—304 wrecks. On Irish coast, 168 wrecks. Greatest number of wrecks occurred during a S.W. wind; and, after that, during a south-easter. Out of the whole 1,170, only 11 occurred during a hurricane: while 15 occurred during a dead calm, and 31 during a light steerage-way breeze.

New "Street Tablets," similar to those in use at Paris and other continental towns, are being placed (experimentally) in different parts of the City. The names of streets have also, in some localities, been affixed to the public lamps, to afford information to passengers at night.

The Cost of Draining, Planting, and Otherwise Permanently Improving the "Woods and Forests" for the year 1857-8, was £54,933. Gross income of the commissions for same period, £417,069: net income, £276,654; management, £77,806. Since 1816, there has been a gradual increase in gross income—viz., from £201,153 in 1816 up to £417,069 present amount, as above.

The National Life-boat Association, since its formation, has expended on life-boat establishments, £28,061, and has voted 81 gold and 629 silver medals for saving life; besides pecuniary rewards, amounting together to £11,651. It now possesses 81 thoroughly equipped life-boat establishments, 15 of which have been added during the last twelve months. A new boat is now building for Kilmore. All the latter boats are on the self-righting principle. 106 persons have been saved by the institution life-boats during the last year.

Cotton-twist [Holland].—In the Dutch Parliament (late advices from the Hague), a motion has been carried for the total abolition of duty on cotton-twist, it being held to be raw material for the textile manufactures.

The Glass-Blowers' Strike, or rather the masters' "lock-out," is understood to have come to an end. It has lasted in England for about two months; and work has been stopped, in Scotland, for about six weeks. In that time, a fund of £11,000, laid aside to support the movement, has been expended.

RAILWAYS, &c.

Railway Employés.—According to the Return, recently laid before the House of Commons, of the number of persons employed upon the construction and working of all the railways of the United Kingdom, there were, at the end of June, 1858, employed in the whole of the United Kingdom, 147,422 persons, against 153,697 in 1857, viz., 112,623 in England and Wales, 18,980 in Scotland, and 15,819 in Ireland. Secretaries and managers, 359; treasurers, 47; engineers, 331; superintenden.s, 532; storekeepers, 283; accountants and cashiers, 1,390; station-masters, 2,679; ticket-collectors, 447; draughtsmen, 235; clerks, 9,072; foremen, 2,444; engine-drivers, 3,508; deputy drivers and firemen, 3,586; guards and breaksmen, 3,747; switchmen, 3,431; gatekeepers, 2,084; policemen and watchmen, 2,385; porters and messengers, 17,250; platelayers, 8,874; artificers, 25,675; labourers, 55,553; not classified, 3,220. Length of line open for traffic, 9,323 miles.

The North-Western Company, although not possessing absolutely the greatest length of railway (their mileage is 658), employ by far the greatest number of persons, their total being 12,535,—they having the greatest number of stations of any line, viz., 359.

The Great Western (mileage 155) employs 8,094; having only 155 stations.

The North-Eastern exceeds the North-Western in length, measuring 720 miles.

Cape Town to Wellington.—The works for this line are about to be commenced. The Government selection of Fort Knokke as a terminus being objected to, another survey (advices to 21st January ult.) was to be made.

A Fatal Railway Accident occurred, morning of 26th February ult., on the Rugby and Leamington Railway (a branch of the London and North-Western Line), three persons killed. A down-train (consisting of a van, horse-box, a composite carriage, break-van, and engine) was thrown from the line, about a mile from Leamington, the spring of the engine having broken off about 150 yards before the engine was thrown off the line. Engine having lost its equilibrium, soon fell on its side; and the frightful collision of the carriages happened as a consequence of their being stopped by the engine. Passengers escaped material injury; but the engine-driver, the stoker, and another man were smashed to pieces under the tender and carriages. Cast-iron chairs, supporting the left-hand rail, split throughout for a distance of about 20 yards, until reaching place of accident, where the whole of the rails are torn up for about 30 yards. Telegraph-wires damaged by falling engine; and telegraphic communication between Leamington and Rugby temporarily interrupted. Traffic on the line resumed same evening.

Irish Railways.—The works on the Tullamore and Athlone Branch Line of the Great Southern and Western [of Ireland] Railway Company, are in a forward state; those on the line from Mallow to Fermoy are likewise in progress, but, being of a difficult character, may prove tedious.

The Tralee and Killarney Railway, entire length, is expected to be open in May.

Railways in the Punjab.—The Moultan and Umritsir Line (240 miles in length) has been commenced, the first sod was turned on the 8th February last by the Lieutenant-Governor Sir John Lawrence, amidst great rejoicings. The wheelbarrow used on the occasion was a very handsome one, made of Sissoo wood, French-polished; the trowel of silver, richly ornamented, having a locomotive engraved on it named "Lawrence," and bearing a suitable commemorative inscription. Above the locomotive, in a scroll, was the happily-conceived motto—"Tam bello quam pace" (both for Peace and War).

"Strategetic" Railways in England. — Plumstead to Woolwich Arsenal.—The system of what the French term the "Strategetic Railways" would seem to have now been inaugurated in England. On the 22nd March ult. the South Eastern Railway Company, under an engagement with Her Majesty's Government, continued operations for laying down an immediate extension of their line of rails from Plumstead to Woolwich Arsenal. A gateway was broken through the wall, at the southern boundary of the Royal Arsenal, for the junction of the line, which will facilitate a speedy transport of guns and war stores to the coast defences, in the event of any sudden or pressing emergency.

Level Crossings.—A Fatal Accident on the South Eastern Railway occurred 21st March ult. As the parliamentary down-train was nearing the Ash Gate level crossing, Ramsgate, a person crossing the line at the gate was struck by the buffer of the engine, and instantly killed.

Leaping From an Engine.—On the Ardrossan Branch of the Glasgow and South-Western Railway (18t March ult.), a fireman, in attempting to leap off the engine while it was in motion fell underneath the wheels, and was killed on the spot.

The Honduras Interoceanic Railway.—A deputation from this Company had (23rd March ult.) an interview with Lord Colchester, postmaster-general, the main object being to urge on his lordship's attention the facilities of this route, as affording the most speedy and safe communication with British Columbia and Australia. The Company has a tender to put a sufficient road for the carriage of the mails, within twelve months from this time, pending the construction of the railway.

The South Eastern Railway, according to a recent statement of the chairman (the Hon. James Byng), has, during the last year, carried 9½ millions of passengers, or more than one-third of the entire population of the United Kingdom. The increase (of 200,000 passengers in the continental traffic) was ascribed to the relaxation of restrictions on continental travelling.

Railway Accidents.—From a Parliamentary return just issued, it appears that the number of accidents to railway trains in England, Wales, Scotland, and Ireland, and of persons killed and injured thereby, during the half-year ending December 31, 1858, is as follows:—Number of accidents, 29; passengers killed, 15; injured, 322. Servants of companies killed, 7; ditto injured, 7: neither passengers nor servants of companies, 1 killed, 1 injured. Total killed, 23; injured, 344.

A Model [Subway] Railway Carriage is on view at the Guildhall. It represents the body of the narrow-gauge second-class railway carriage to be used on the Metropolitan Subway Railroad. It is 9 ft. wide by 40 ft. in length, and 8 ft. high. For the broad-gauge line, from the Great-Western, the carriages will be 2 ft. wider. Carriages to be lighted with gas; to be aired by a process of ventilation by which the gas may be kept at any desired height; and the air be constantly undergoing the requisite process of change without creating any perceptible draught. Similar carriages to be made available for clerks, warehousemen, mechanics, artizans, and others. Cushioned seats in each carriage, for 90 persons.

The Roman Railway Works are progressing, under the superintendence of M. Mirès. The line from Civita Vecchia to Rome will shortly (it is expected by the beginning of April) be opened to the public, so that visitors to Rome at Easter may enjoy the benefit of the railway.

Charing Cross and London Bridge [Proposed New] Line.—The South-Eastern Company have adopted the recommendation of their Directors to contribute £300,000 towards the Charing-cross project, "as the terminus, being in the very centre of the western part of London, would be highly beneficial to the Company."

East Indian Lines.—Great Indian Peninsula.—Total expenditure, on the 30th June, 1858 (last report to Secretary of State for India in Council to that date), on the 88½ miles open for traffic in the Concan, and 42 miles in the Deccan—together, 130½ miles,—was £833,794, or £6,389 per mile, exclusive of rolling stock. Expenditure on the Bhore-Ghât incline, 15¾ miles in length, £114,312 out of £426,860, the contract price. On contract, from Poonah to Sholapore, 163 miles in length, £132,314 expended. From Wassend to Rotunda Nullah, 25 miles, £83,701 expended: on Thull-Ghât incline, 9 miles in length, £4,451 expended. From Egutpora to Bhosawal, 190 miles, £35,636 expended. From Bhosawal to Jubbulpore, 332 miles, contracts not let. Portion of line open for traffic, 130½ miles. Net profit for the year ending 30th June, 1858, equal to £3 13s. 8d. per cent. on the whole cost.

Railway Traffic.—Report presented to Parliament (8th March ult.) containing returns of the number of passengers conveyed on all the railways in England, Wales, Scotland, and Ireland, during half-year ending 30th June, 1858. Of passengers, 52 millions had travelled over the lines in the half-year preceding that date, 20 millions being passengers by Parliamentary trains; 10 million tons of general merchandise; 18 million tons of coal and other minerals; 873,000 head of cattle; and 3 million sheep and pigs. Total number of miles travelled by train, 35 millions. Length of line opened in England and Wales on 30th June, 1858, was 6,895 miles. Total receipts, from all sources of traffic, £9,406,000; viz., from passengers' fares, 3 millions; general merchandise, about the same sum; and 1½ millions from coal and other minerals.

In Scotland.—Total number of passengers, about 6½ millions, paying £386,000 for themselves, and £25,000 for horses, dogs, carriages, &c.; number of miles travelled over by trains, 4 millions; total receipts from all sources of traffic, £1,118,000.

In Ireland.—Total number of passengers, 3½ millions, paying for themselves, their horses, and luggage, £308,000. Total number of miles travelled over, 2 millions; total receipts, £546,000.

Total Number of Miles travelled over in the United Kingdom was 42 millions, and total receipts, 11 millions.

Marseilles to Toulon.—This important line of railway, it is announced, will be opened to the public on May 1. Trains already (advices to 13th March ult.) run between the two ports on military service.

The Total Length of Line at present Open for Traffic in the United Kingdom is 9,323 miles.

On the (at present) Unopened Railways of the United Kingdom, out of a total of 3,800 persons employed, 31,000 are labourers.

Crossing Rails.—As the express train from London was (15th March ult.) approaching the Fence Houses Station on the York, Newcastle, and Berwick Railway, a lady, unobservant of its close proximity, attempted to cross the rails, when the buffer of the engine threw her with such violence against the station-wall that she was killed instantaneously. The manager of the line happened to be in the train at the time, and the train being stopped, he alighted, offering every assistance, but it was of no avail, and the train proceeded northwards.

On the Lancashire and Yorkshire Railway, near Wigan, a fatal accident occurred (14th March ult.) from a similar cause. A foreman of some neighbouring coke works, and a collier, had taken shelter under a bridge, when a passenger-train from Liverpool approaching, they ran upon the space between the two lines. At the moment, a goods train, in the opposite direction, also passed them, and they were instantly knocked down—one of them being killed on the spot, and the other having his arm fractured.

Locomotive off the Rail.—Recently, at the Bamber-Bridge Station, on the East Lancashire Railway, an engine ran off the line, broke a gate and posts, then caught the corner of a house abutting on the railway, knocking the gable down entirely, and carrying away a portion of the wall. The whole interior of the house was thus displayed to view. A women who was washing in the back kitchen luckily escaped unhurt; and the engine-driver, who shut off the steam as quickly as possible, also escaped injury. Damage done, estimated at not less than £200.

A Subscription Testimonial to Mr. Chas. Francis, for upwards of 20 years chief clerk in the locomotive department of the London, Brighton, and South-Coast Railway, was (5th March ult.), presented, at a banquet, given on the occasion, in the Reading-room, at the Brighton Railway Station, and attended by more than 200 of the principal officers and *employés* of the establishment. The testimonial consisted of a handsome gold watch, with massive gold guard-chain, value 35 guineas, the inner case bearing the following engraved inscription:—"Presented to Mr. C. Francis by the officers and *employés* of the London, Brighton, and South-Coast Railway Company, as a token of their respect and esteem. March 6th, 1859." The Chairman (Mr. J. C. Craven, Superintendent of the Locomotive and Carriage Department) made an appropriate address on the occasion, highly eulogistic of the official merits of Mr. Francis, and of the efficient manner in which for so many years he had discharged the duties of his position.

Tram-Roads in Paris.—The carriages which run on the iron tram-road to St. Cloud, Sèvres, and Versailles, and which have hitherto started from the entrance of the Cours la Reine, on the Place de la Concorde, now take up passengers in the Rue de Louvre, in front of the Colonnade. In order that the projecting part of the tire of the wheels of the carriages may not injure the road of the Quai des Tuileries and du Louvre, over which they have to pass, a contrivance has been resorted to, by means of which they can be removed, and replaced at the station of the Cours la Reine when the carriages go on the rails.

Spanish Lines.—On the Madrid and Saragossa, the section from Madrid to Quadalaxara is nearly terminated—60 kilometres long. Inauguration to take place very shortly.

On the North Spanish, the sections of Avila to Valladolid, and from Valladolid to Burgos, altogether 250 kilometres, are announced for completion in a few months.

San Isidro de Duenas to Alar (same line).—Earthworks and masonry terminated—110 kilometres.

Alar to Santander, 36 kilometres, announced to be finished in present year.

Almansa to Valentia.—Works finished to within a few kilometres of the end of the line.

The Seville and Cordova.—Seville and Jerez, and Puerta Real and Cadiz, are in same state of active progress towards completion this year.

From Barcelona to Saragossa.—On different points on this line, more than 16,000 workmen are employed. Company's daily expenditure for salaries, 10,000 *piastres fortes*, or 50,000 francs and upwards. Completion expected towards end of this year.

German Railways.—During the year 1858, in Germany 129½ miles of railways were opened—(the German mile has 7,408 kilometres in length)—namely, 24½ belonging to different governments, and 105 to companies.

The London Bridge to Charing Cross [Proposed] Railway is being opposed in its progress through Parliament by Counsel on behalf of the Metropolitan Board of Works, on the ground that "the construction of the line is unnecessary." It is supported on the other hand by the favourable opinion of the City police and municipal authorities, the inspector-general of mails, the inspector-general of fortifications, the Admiralty, and the Board of Trade, who have strongly declared their opinion that the proposed Charing Cross railway will prove of great service, and, by relieving the enormous and increasing pressure of traffic on London Bridge, &c., afford an immense amount of accommodation to the public.

On the Toulon and Marseilles Strategetic Line of Railway 800 French soldiers are (advices to 20th March ult.) actively at work.

TELEGRAPH ENGINEERING, &c.

The London District Telegraph Company have notified that they are prepared to arrange for the supply of private wires between branch establishments in the metropolis.

Naples and Malta.—On the question of this [proposed] submarine line, Lord Derby, recently, in the House of Lords, stated that three applications [from companies] had been made for laying down a submarine wire between these places, and that the Government would not oppose, neither were they prepared to assist, these efforts.

The Over-house Telegraph System is being extended; a series of lofty poles has been erected between the premises of Her Majesty's Printing Office, Fleet Street, and the Parliament Houses, Westminster, the wires being conveyed across the Thames, from the Surrey side, to one of the towers. Line constructed on Owen Rowland's new over-house system, nearly 2 miles in length. The wire is of steel, thoroughly painted, supported along a series of lofty poles, twelve in number: the wire is fixed to several of the towers at the royal palace, and, for about 500 ft., conveyed below the roofing of the various offices in the building. The line was completed and in practical operation on the 5th March ult.

The Red Sea Submarine Telegraph Company have obtained a guarantee from the Government; the terms of such grant were explained by Lord Derby in a recent sitting of the House of Lords.

Malta and Cagliari.—Another interruption on this line occurred at 2 a.m., 6th March ult, and has since continued. The actual cause of accident has not as yet transpired.

Telegraphs in America.—The National Telegraph Line is now working in one unbroken circuit from New York to Leavenworth, Kansas, and, subsequently, to Prairie du Chien, Wis. Messages are sent and received with the same promptness with which they could be sent 50 miles. The distance by the wires to Leavenworth is nearly 2,000 miles.

The Atlantic Cable.—The chairman of the Company (Right Hon. J. Stuart Wortley, M.P.) announced (25th February ult.) that the Government will grant a guarantee of 8 per cent. on £600,000 for 25 years on certain conditions; and that the cable remained in exactly the same state as heretofore, the directors having no adequate funds for lifting and repairing it. A new Act is to be obtained to raise the necessary capital.

The Condition for such Guarantee was subsequently (28th Feb. ult.) announced by Lord Derby in the House of Lords to be that the line is in a working state—*i.e.*, that the guarantee of 8 per cent. had been given to the Atlantic Telegraph Company on a certain portion of their capital; that such guarantee depended on the successful laying down of the cable, and would only remain in force during the successful working of the telegraph.

Electric Cables—Action of Salt-water.—Professor Hughes has recently made some interesting experiments as to the action of salt-water on insufficiently insulated electric cables. An insulated wire was immersed in salt-water, and its perfect insulation ascertained by the most delicate galvanometer. Insulation then destroyed by cutting a large hole in the gutta-percha covering of the wire; galvanometer showed that the *whole* of the electric current was escaping through it. Experiment repeated, with a more *minute* hole in the gutta-percha, when the galvanometer, instead of becoming stationary at any point, vibrated in an arc of 2 or 3 degrees of each side of 70 degrees. It is hence inferred that in the case of the Atlantic cable, phenomena which were supposed to arise from the variable nature of earth currents, were, in reality, produced by the same causes which were in action in the experiments; and showed that the flaw in the insulation was probably trifling in extent. To obviate this, he proposes to interpose a film of viscid fluid between the wire and gutta percha of submarine cables, which would ooze out through any flaw, and completely stop it up.

Van Diemen's Land and Victoria.—Circular Head, one of the recent settlements of the Van Diemen's Land Company, is to be the first station where the submarine cable, connecting the latter colony with Victoria, is to be landed; and the Directors of the Van Diemen's Land Company have sanctioned the grant of a site for the purpose.

Telegraph Messages across Water without Wires.—Mr. J. B. Lindsay is experimenting at Victoria Lock and Dock, Dundee, on his principle of transmitting telegraph messages across the water without the intervention of wires. Words were accurately sent to distances varying from 76 to 500 ft. An experiment is to be made over the Tay, in the vicinity of Perth, where it is 1,000 ft. broad.

India-rubber as an Insulator for submarine wire, in lieu of gutta-percha, has recently been practically tested at the india-rubber works of Messrs. Silver and Co., Silvertown, on the North Woolwich line. By their (recently) patented process, a perfectly solid covering, impermeable to water, even under hydraulic pressure of upwards of a thousand atmospheres, is made to protect the wire, and to insure its perfect insulation. The main advantage of the proposed substitute consists in the unalterability of india-rubber (as compared with gutta percha) by increase of temperature.

Dock Telegraphs.—The Mersey Dock and Harbour Board have accepted the tender of Messrs. Burrows and Fulton for the wire for the dock telegraph, to be supplied at the rate of £17 per ton; and for insulators (Messrs. Reid), at 6d. a piece.

Submarine Cables.—Undeterred, it appears, by the fate of the great Atlantic affair, the leading submarine cable makers are now willing to contract for the successful submergence of an Atlantic wire, taking all the risk of loss or damage upon themselves. As to the old cable at Valentia, no change has taken place in its condition. No hopes are now entertained of its being further utilised.

MARINE STEAM ENGINEERING, SHIPBUILDING, &c.

The Royal Steam Navy.—The late Parliamentary return shows that from 1847 to 1858, 354 steam-vessels have been added to the Navy. 21 of these were "converted," and 100 built outright. In 1856, as many as 123 were purchased. Steam navy actually afloat, on 1st January last, consisted of 431 vessels (319 screw, and 112 paddles). 32 screws were in progress of building or "conversion," thus classified:—ships of the line, 33 screws; frigates, 19 screws and 9 paddles; block-ships, 9 screws; mortar-ships, 4 screws; corvettes and sloops, 38 screws and 35 paddles; small vessels, 3 screws and 24 paddles; gun-vessels, 26 screws; ditto "boats," 161 screws; floating batteries, 8 screws; tenders, &c., 4 screws and 38 paddles; troop and store ships, 12 screws and 2 paddles; yachts, 1 screw and 4 paddles. Of the screw "liners" only 33 are afloat, and 28 frigates; but the return gives a total of 49 liners (*i.e.*, 33 afloat and 16 in building); 34 frigates (*i.e.*, 28 afloat and 6 in progress of building. Total number of vessels afloat includes 319 screws and 112 paddles, making a grand total of 431 afloat, and 32 in progress of building or conversion.

The Galway Line.—The Government (22nd February ult.) have recommended the Treasury to negotiate with the Atlantic Steam Company a contract for a fortnightly mail service between Galway and America, Boston and New York being alternately the ports of destination. Rate of payment not to exceed £3,000 the trip.

The "Circassian" Galway Steam Liner, on her passage out to St. John's, Newfoundland, encountered extremely boisterous weather, ran short of coals, and had to burn her spare spars. She arrived at New York on the 11th February ult., after a passage of 30 days, in tow of a steam-tug, having lost her screw between St. John's and New York.

Canada and England—Toronto (March ult.)—In the Canadian Parliament, the Hon. Mr. Morse presented a petition from the Hon. John Young, and others, for an Act of incorporation for a company to connect the continent (Canada) by a submarine telegraph with Great Britain, *viâ* Greenland, Iceland, and the Faroe Islands.

The British Steam Navy, at the beginning of the present year, 1859, consisted of the following vessels:—

	Afloat.		Building or Converting.	Total.
	Screw.	Paddle.	Screw.	
Ships of the Line	33	—	16	49
Frigates	19	9	6	34
Block Ships	9	—	—	9
Mortar Ships	4	—	—	4
Corvettes and Sloops	38	35	9	82
Small Vessels	3	24	—	27
Gun Vessels	26	—	—	26
Gun Boats	161	—	1	162
Floating Batteries	8	—	—	8
Tenders, &c	4	38	—	42
Troops and Store Ships	13	2	—	15
Yachts	1	4	—	5
Total	319	112	32	463

H.M. Screw Steam-frigate "Termagant," 25, got up, recently, her steam in Portsmouth Harbour, to proceed to Spithead, but, just before starting, it was found that the screw could not be lowered into its proper position; and, in endeavouring to ascertain the cause of this, a leak was discovered in her slop-room, which would, probably, require the ship to be placed in dock.

The "Scotia" (S.S.), from Rouen, and from Milford (after coaling) for the Clyde, was abandoned at 10·30 p.m. (22nd Feb. ult.) off Stockholm Island, with 7 ft. water in her engine-room, caused by the connecting-rod breaking and going through the condenser: fires put out in three minutes: crew saved by her life-boats.

Steamers on the Amour.—By late advices by the *Tartar* Overland Mail, through Siberia, for Russia *viâ* Irkoutzk, capital of the Frozen Provinces, we learn that a Californian steamer, built by Barling and Co., at San Francisco, is at full work navigating the Amour, with goods and passengers. It is on the American plan, of covered deck, high above water, and 50 H.P., with light draught.

Pinhey's Ship's-Compass Corrector.—The steamer *Ripon* (Peninsular and Oriental Company), on her recent passage outward, was steamed round to adjust her compasses by Mr. Pinney's corrector, the inventor being attached to this ship as chief officer. The errors of three compasses were taken on 32 points, the ship being out of sight of land: time occupied, 15 minutes. Navigated from Malta to Alexandria, and back to Southampton, by these errors; and the landfalls made were exact as steered for.

The "Vulture" Steam-frigate is to be docked at Malta for the purpose of repairing damages sustained some time ago on the coast of Barbary.

"The Prince Frederick William of Prussia," English Mail Steamer (belonging to the Continental Royal Mail Steam Packet Company), on entering Calais Harbour (at night on the 27th Feb. ult.), during a violent gale from the north-west, ran foul of the pier. One of the wheels damaged, and steamer driven back into the Channel. Three passengers perished. All the other passengers, together with the Indian and usual mails, landed in safety. On the following (Monday) night, at 9 p.m., she was safely towed into Calais Harbour, with no other damage to her hull beyond two small holes in two of her plates, which filled the fore compartments with water. An investigation has (19th March) been ordered by the Marine Department of the Board of Trade. The inquiry commenced 23rd March ult., at Dover, before the Mayor and two other borough magistrates. The Solicitor to the Customs conducted the investigation on behalf of the Board of Trade. The master of the steamer, in his examination, attributed the original striking of the vessel to an incorrect allowance for the sea by the pilot on the pier. The acting British Consul at Calais gave evidence as to his requesting the deputy harbour master to get the life-boat out. Two hours were occupied in getting it out! There was the regular crew to the life-boat, nor had the boat been out of the house since it was presented to the town of Calais. 26th March—Inquiry concluded. The Mayor said he had great satisfaction in handing to Captain Pittock his certificate. Report would be forwarded to Board of Trade.

Wire-rope Bobstays for Steamers, on a new principle, are ordered to be fitted to the *Royal Sovereign*, 131, in the steam-basin at Portsmouth. The end of the bobstay fits, with an eye, to a hook on the head knee.

The "Mersey," 40, Screw Steam-frigate, having been completed with all expedition in the steam-basin at Portsmouth, and taken in the hollow shot for her 10-inch main-deck guns, spare spars, &c., and coaling, was (17th March ult.) towed out of basin preparatory to trial being made of her speed. Owing, however, to the boisterous state of the weather, the trial-trip was postponed. 18th March ult.—Proceeded out of harbour, and as far as Dunnose, to make trial of her propelling engines, and of the auxiliary engines fitted on board to be used in case of fire. On going out of harbour, the force of the tide turned her head nearly into the Quebec Hotel, and she was obliged to anchor for some time. Her engines worked well.

The Dutch Barque "Equator" was entirely destroyed by fire, on the night of the 19th March ult., in the river Mersey. Bound to Batavia: cargo, silk, cloth, and fine goods, valued at £60,000. Owners, Messrs. Voys and Co. One man killed by the mizen-mast falling into his gig, which was alongside the vessel.

Lights and Fog Signals.—The Swedish and Norwegian minister for Foreign Affairs has notified to Her Majesty's Government that the regulations for the use of lights and fog signals on board ships, established by the British Admiralty, have been adopted in the royal and merchant navies of Sweden.

Capt. Kynaston's "Life-boat Hooks" were, on a recent occasion, found to be highly efficacious. Off Alexandria (1st March ult.) a seaman fell overboard from the screw steam frigate *Euryalus*, 51. A 28 ft. cutter, fitted with these life-boat hooks, was, with her crew, disengaged with great facility, although on the weather side, and the man saved. The circumstance had attracted the attention of the Pacha of Egypt, who expressed a particular wish to witness on board the working of the hooks, when the weather moderated.

The Cunard Steamer Line.—The dignity of baronet has been conferred (announcement in "London Gazette," 1st March ult.), on Samuel Cunard, of Bush Hill, Middlesex, Esq., the successful founder of this packet-line between England and America.

The "Dnieper" Screw-steamer, according to telegram from Constantinople, 23rd February ult., had parted into three pieces. French engineers had arrived, and would leave same evening for pieces.

The Great Eastern advances towards completion (of her fittings). Her original destination was Portland, where every preparation had, previously to her late change of owners, been made to receive her; and that, according to an official declaration made by the chairman of the present company at a recent meeting of the shareholders, will be the first place the ship will be sent to; but her future destination will be India. The finishing of the great ship, it is understood, is to be entrusted to Mr. John Scott Russell: the poop and forecastle decks, which would increase the height of the ship about 4 ft., are not to be added. Stowage-room for 300 passengers will thus be lost.

The Newly-Invented [French] Steam "Armed Boats," now actually constructing at Ciotat, close to Marseilles, are steamers, flat, and of small size (eleven in number: carry one gun each, on a swivel; both gunners and gun protected by an iron shed so fashioned that the enemy's balls will glide off on either side, without doing any harm. Boats made to be taken to pieces, and carried overland, if necessary; and put together in an incredibly short space of time. Plan furnished by a naval architect at Bordeaux.

The Steamer "Lapwing" sailed from Glasgow (21st February ult.), for Oban, Fort William, and Inverness, followed by the screw-steamer *Isleman*, for the Western Isles. About midway between Sonda and Campletown Lock, she came in contact with the *Isleman*, which struck her before the paddle-box on the starboard side, whereby she was so much injured that she sank in about three minutes. Crew and passengers saved on board the *Campletown*, with exception of one woman and a cabin-boy, both below at the time.

The "Screw."—"Reconstruction" of the British Navy.—In the recent debate on the state of the navy, Sir J. Pakington vindicated the use of the word "*reconstruction*" in the speech from the throne; adding that "surely that was the proper term for a change which commenced with the introduction of the screw-propeller into our navy." The objection [made by a previous speaker] to the use of the term, he, Sir John, characterised as "a sort of minute, and not very worthy criticism," considering the Government proposal to add, in one year, twenty-six men-of-war to the navy—"a step in reconstruction such as had not been attempted by any former Administration."

Iron-cased Ships.—On the same occasion, the First Lord of the Admiralty said, "Upon the subject of iron-cased ships, the result of experiments was, that, whatever be the cost, there was no option but to commence the construction of such ships."

Steam Machinery for the Navy.—On the Navy Estimate debates, Sir J. Pakington stated that in 1858 we had expended no less than £4,000,000 in providing steam-engines for the Royal Navy. In the course of last summer, a committee was appointed, consisting of Admiral Ramsden, Mr. John Ward, and Mr. Nasmyth, to investigate the state of the steam-machinery of the navy, and to ascertain a mode of supplying engines to our vessels on the best, most approved, and most scientific principles. One of the recommendations of this committee is to be adopted by the Admiralty, namely, to invite tenders from Liverpool, Scotland, and most of the eminent houses engaged in this particular business.

The Addition [of Steam-ships] to be made to our Navy, this year, is officially announced to be—twenty-six powerful men-of-war, of which fifteen will be steam line-of-battle ships; a number of frigates; equal to nearly half the existing number of heavy frigates; and two iron-cased ships, as powerful as can be made. In other words, the British Navy will be increased, altogether, from twenty-nine line-of-battle ships and thirty-four frigates, to forty-four line-of-battle ships and forty-three frigates.

Collision and Loss of a Steamer.—At Dartmouth, 5th March ult., the *Beagle*, from Oporto, had put back leaky, with head, cutwater, and rails carried away, stern split, and other damage, having been in contact (on preceding morning, about 38 miles S.W. half W. of the Eddystone) with the screw-steamer *Thalia*, from Cadiz to London, with cargo of wine and lead, which sunk. Crew saved by the *Beagle*.

A Large Screw-steamer,—the "Bulwark," 91 guns—one of several line-of-battle steam-ships ordered to be built at Chatham Dockyard, has been put in hand; on the 9th March ult. a large number of shipwrights commenced preparing the timbers for laying her down on No. 7 slip.

The "Charybdis," Screw Corvette, 21, constructing in Chatham Dockyard, is immediately to be brought forward for launching; the shipwrights having (9th March ult.) resumed work on board.

The "James Watt," Screw Steam-ship, 91, got up steam in Hamoaze, Plymouth, on the 10th March ult.; but as her machinery did not work satisfactorily, she was to be taken again into Keyham steam-yard.

A New 16-gun Screw Corvette, to be called the *Reindeer*, is to be immediately laid down on No. 1 slip in Chatham Dockyard.

The "Orpheus," 22, Screw Steam Corvette, building at Chatham Dockyard, is to be launched forthwith.

The Paddle-wheel Steam-ship "Ardent," 5, went ashore some time since at Great Popo, in the Bights of Benin, on the African coast, during a dense fog, and was only got off with the loss of her guns, ammunition, stores, &c., by the united efforts of the steam-ship *Hydra* and others. Both hull and machinery damaged. Arrived in Plymouth Sound 10th March ult. Her grounding is expected to form the subject of an official inquiry.

The Cost of Steam Machinery for the British Navy, for the six years between 1852-3 and 1857-8, as officially stated, was £3,423,023.

The Pacha of Egypt's Yacht, "Faid Gehaad," which left Southampton 17th March ult. for Alexandria, put (18th ult.) into Falmouth, with her engines damaged.

Steam Flotilla to ply on the Lower Danube.—An enterprising skipper at Marseilles, of the name of Magnan, long connected with the trade of the Lower Danube, has organised a flotilla of ten steamers, ready for that destination. Six of them are sea going boats; but four are fresh-water craft. The six started recently, with the four on board, by long sea to the Sulina mouth of the river. He had applied in vain for permission to send the four fresh-water barks by the water communication which exists between the Rhone and the Danube, by the canal which connects the Soane with the Rhine, the Rhine with the Mein, and the latter river with the Bavarian Danube; but Munich would not grant a passport to these small French steamers. At Semlin, last year, the Austrian gunners fired on the tricolour flag borne by one of them. Such is the "free navigation" as understood at Vienna.

Cost of building Men-of-War.—The cost of building the hull of the *Indefatigable*, a 50-gun frigate, in 1852-3, was £51,836; but the *Shannon*, also a 50-gun frigate, cost £71,112; and the *Orlando*, a new steam-frigate, launched last summer, cost £99,375.

The Construction of the "Britannia," 121 guns, required 4,550 loads of rough timber, and 218 shipwrights; while the *Marlborough*, the same class of vessel, recently built, required 6,068 loads of timber, and 334 shipwrights. The *Rodney* required 3,610 loads of timber, and 219 shipwrights; while the *Renown*, a vessel ot the same class, but lately built, required but 4,680 loads of timber, and 277 shipwrights.

At Chatham Dockyard (3rd March ult.) 250 additional shipwrights, and 36 other artizans, were ordered from the Admiralty to be immediately entered, in order to hasten forward the completion of those line-of-battle ships now on the stocks, several other additional vessels being ordered to be immediately laid down. The whole of the workmen employed in this dockyard are also to be employed on taskwork overtime, as during the Russian war.

The Item of Cost of Shipbuilding for the British Navy, for the six years between 1852-3 and 1857-8, as officially stated, was £2,821,406—the aggregate cost (including shipbuilding, converting, steam machinery, repairing, fitting for sea, &c.), was £12,286,517.

At Woolwich Dockyard the whole of the shipwrights are employed on the system of job and taskwork (Admiralty order dating from 7th March ult.); and 50 additional shipwrights and 6 caulkers have been set on, to complete the vessels in hand for commission.

The Gun-boat "Sandfly" (tender to the *Cornwallis*), having had her defects repaired at Sheerness, proceeded (19th March ult.) on a trial of her machinery. Result of trial satisfactory, with an average pressure of 63, she made (on average) 148 revolutions; and 8½ knots an hour.

The "Trafalgar," 91, line-of-battle screw-steamer, having been altered from a 120-gun sailing-ship, was, 19th March ult., floated out of No. 2 dock, at Chatham, to be replaced by

The "Rodney," 90, into the same dock, where she is to be fitted with a screw.

The Ill-fated Steamer "Czar," wrecked near the Lizard, is having her naval and other stores, as far as possible, recovered (by two salvage-cutters, with diving apparatus, as the weather admits of operations) and brought to Falmouth. Portions of her machinery have also been recovered, but great bulk of cargo still unsaved.

Collision.—The Steam-ship "Persia," for New York, ran foul of and sunk the brig *Agnes*, of Glasgow, from Troon for St. Vincent, West Indies, about 20 miles E.N.E. of Tuskan. Crew and passengers, sixteen in number, rescued by the *Persia*.

The "Euxine" Steam-ship (Peninsular and Oriental Company), lately engaged on the Marseilles and Alexandria Line, has (Southampton, 22nd March ult.) come home for repairs.

Further Steam Communication with America.—The Liverpool, New York, and Philadelphia Shipping Company, announced (24th March ult.) that one of their steamers—the screw-steamer *City of Manchester*—will sail from Belfast on April 6th, and from Queenstown on the 8th, direct for New York.

Steamer Launch on the Clyde.—From the shipbuilding-yard of Messrs R. Napier and Sons, at Gowan (19th March ult.), the paddle Royal Mail steamship *Shannon*, for the West India Royal Mail Steam Packet Company—sister to the *Paramatta* and *Seine*, now in process of construction by the Thames Shipbuilding Company, at Blackwall.

	Dimensions. ft.	in.
Length over all	242	0
Length of keel	330	0
Length on load-line	327	6
Breadth of beam	44	0
Depth of spar deck	30	0
Tonnage (builder's measurement)	3,092 tons	

Will be propelled by two side-lever engines of 800 H.P. Cylinders 96 in. in diameter, with 9 ft. stroke: paddle-wheels to be fitted with feathering floaters: engines and boilers now completed, at Lancefield Works. Stern bow (new style). Flush decked. Her bottom plates 15-16ths and ⅞ths of an in. thick, varying to ⅝ths above main deck; shear plates 1 in. thick. Intended to be placed on trunk line for the Peninsular route. Her steam is expected to be up early in June, and she is to take her station about the middle of July.

The "Rodney," 90, Line-of-battle Sailing Ship, was, 22nd March ult., hauled into the (Chatham) dock, vacated by the *Trafalgar*, 91, for the purpose of being converted into a screw steamer.

The "Trafalgar," 91, was towed by the *Adder* and *African* steamers, 21st March ult., from Chatham dock to Sheerness, where she was docked, to be fitted with her screw machinery.

The "Charybdis," 21, and "Orpheus" 21, Screw Corvettes, are progressing rapidly at Chatham dock.

The Trial-trip of the Mersey, 40, Screw Steam Frigate, to test her speed at the measured mile in Stokes Bay, out of Portsmouth Harbour, took place at noon, March 24th ult., and proved highly satisfactory. There was not the slightest appearance of "priming of boilers," or "heated bearings," so common in first trials. Her nominal power is 1,000 H.P.; but on the trial it was worked up to the enormous power of 4,000 H.P. Average result of speed obtained in the four runs of the measured mile, 13·290 or better than 13½ knots; pressure of steam, 20; vacuum, 24; revolutions (maximum), 56; mean ditto, 55¼; diameter of screw, 20; pitch of ditto, 29; immersion, 6 in.; force of wind, 1·0; direction of wind, N.W.; draft of water—forward, 20 ft. 8 in., ditto aft, 22 ft. 7 in.; coals on board, 850 tons; consumption of fuel at full speed, about 140 tons every twenty-four hours; thermometer in engine-room, 62·0; ditto, stoke-hole, 100·0; ditto on decks, 52·0; length of stoke-hole, 68 ft. 10 in.; breadth of ditto, 10 ft.; number of fires, 32; tops of boilers, 3 ft. under load-water line; engines placed abaft the mainmast, which may in consequence be stepped in the keelson; three auxiliary "donkey" engines are fitted on board, two to supply the boilers, and the other as a steam fire-engine—this is fitted with a 4½ in. copper pipe from the ship's side, under the beams of the orlop deck, fore and aft, with seven 2½ in. pipe-branches up through the lower and main decks. In the event of a fire breaking out in any part of the ship, it is only to turn on the main cock at the ship's side, and any amount of water can be instantly conveyed to any part of the ship.

The "Mersey's" Armament consists of, on upper deck, twelve 8 in. pivot-guns 10 ft. 6 in. long, throwing a solid shot of 68 lbs.; main deck, twenty-eight 10 in. guns, 9 ft. 4 in. long, throwing hollow shot of 84 lbs. Total weight of the guns (without carriages), on the upper and main decks, 178 tons 3 qrs. 2 cwt. A broadside from her would give to an enemy in action 1,625 lbs.

MILITARY ENGINEERING, &c.

Secret Patents for Improvements in Instruments of War.—A bill (by Mr. Sotheron Estcourt and the Secretary of War) has been brought in, to enable the inventor of cannon and other warlike implements to obtain patents without publishing the details of their schemes. They are first to submit the invention to the Secretary for War; and, if he considers the invention of value, he may at once buy it of the inventor, and certify to the Commissioner of Patents that, as it will be for the good of the public service that the invention shall be kept secret, he wishes it to be patented under the provisions of the Act. The specification and drawings are then to be made up into a packet, sealed with the seal of the Secretary for War, and its contents are kept absolutely secret, no copies even being sent to Ireland or Scotland, as is done with every other patent.

The Old "Lancaster" Shell Foundry, in Woolwich Arsenal, was (on the 24th March ult.) taken charge of by the Assistant Engineer for Rifled Ordnance, to immediately commence the manufacture of Sir Wm. Armstrong's Guns, when forty-eight experienced men employed in the Royal Standard Gun Foundry were transferred to the new department.

Breech-loading Rifles for the Navy.—Sir J. Pakington announced in the House of Commons (25th February ult.) that the Admiralty had given orders for a supply of breech-loading rifles, for it was their determination to put into the hands of our seamen the most efficient arm that could be found.

A Newly-Invented Blank Cartridge, proposed by the Superintendent of the Royal Laboratories, and its adoption by the Army sanctioned in a circular memorandum of the General Commanding-in-Chief, for the purpose of assimilating the method of loading with blank to that of loading with ball cartridge. The new pattern is composed of the same number of parts as the service ball-cartridge—viz., an inner bag containing the powder; mock bullet, consisting of a paper bag, with a muslin bottom, filled with fine grain powder; and an outside bag to contain both. In order to insure the flash of the discharge igniting the powder in the mock bullet, and to prevent its being projected from the musket entire, a portion of the bottom of the outside bag is cut away. In loading, the necessity is to be inculcated on the soldier of invariably reversing the new pattern blank cartridge, in the same manner as the ball-cartridge, and of inserting the greased end of the cartridge first. No portion of the paper requires to be torn off.

Rifled Ordnance.—The Old Lancaster-Shell Factory, in Woolwich Arsenal, which is well fitted with Nasmyth's ponderous hammers, and other machinery necessary for the new requirements of the improved school of gun construction, was recently visited by Sir William Armstrong, Government Engineer for Rifled Ordnance, for the purpose of inspection. He is to take possession of that establishment as his preliminary department. The additional sum of £4,000 has been demanded as the minimum required to put the factory in complete working order for his purpose.

At the Elswick Works, Newcastle-on-Tyne (belonging to Sir W. Armstrong), it is likewise understood, that the manufacture of the new rifled-cannon will be extensively carried out.

The New [French] System of Artillery, which has been under examination for the last two years, is now said to be completed, and that late experiments have decided its adoption. The various calibres hitherto in use are reduced to two—viz., 12-pounders, or siege guns; and 4-pounders, or field guns. The pieces are rifled; the projectiles are hollow, and produce a double effect—that of solid shot and of shell. Form, conical; and leaden *ailettes* give to the ball a precision never obtained before. A 12-pounder (new model) will, with one half of the number of shots of the old pieces of 24, produce the same effect; and the new pattern 12-pounder produces, at 70 metres, the same result as the old 24 at 35, and requires not more than one-sixth of the charge. The projectiles penetrate into a block of stone of the hardest cement to an extent of 80 centimetres, and an enormous breach is made by the explosion. The advantages of the 4-pounder are described as still more remarkable. It requires but 500 grammes of powder to throw a ball to a distance of one kilometrical league. Precision such that, at the distance of 3,100 metres, it strikes a single man on horseback; and, at that distance, would destroy a body of cavalry or infantry. All the pieces on the new system are loaded at the muzzle; the loading at the breech being given up, as proved to be inconvenient and even dangerous, so much so as to counterbalance the advantages.

The Bogue Forts.—A fine piece of brass ordnance, captured at the storming and taking of these forts, has recently been landed at Chatham Dockyard. This gun—whether of Chinese make or not, does not clearly appear—is of splendid workmanship, weighs nearly 10 tons, and is 16 ft. in length—the bore being 12½ in. Another captured (Chinese) gun, of same size and make, was unfortunately lost overboard, in the attempt to get it on board a homeward-bound vessel.

Warry's Breech-Loading Cannon, modelled on a much larger scale than that formerly tested, has been (25th February ult.) subjected, at Brompton Barracks, to a severe trial. The new gun is 16 in. over all, and 14 in. from breech to muzzle; weight, 11 lbs., exclusive of carriage; gun itself of brass; and (as also mechanism at the breech) of beautiful workmanship; ten rounds can be fired per minute, being as fast as two men can load and fire it. Balls used on this occasion, the ordinary Enfield rifle bullets, and Norton's paper-coated conical balls. Accuracy, at a distance of 2,000 yards, fully demonstrated by experiments. Firing takes place by percussion, each gun being fitted for a percussion-cap. Cartridge cut, nipple pinned, and breech closed, all by one motion of a small lever, placed on left-hand side of gun; so that chance of missing fire is almost entirely obviated. On the 3rd March ult., this gun was again tested; on this occasion as ordnance to be used in firing shell. One of Norton's newly-invented "liquid fire" rifle shells was the projectile selected for this trial. Charge of powder used to fire the shell, only 1 drachm weight, or exactly 1-5th of the weight of the proof charge. A stout plank was erected at the end of the range, for the shell to strike against. On firing, the portion of the plank struck by the shell burst out in a second or two into flame, the "liquid fire" itself being scattered for some distance. The result of the trials was considered most satisfactory. The gun is capable of throwing a shot 2,000 yards, at which distance Captain Norton states that he is prepared to set fire to any combustible matter by one of his shells.

In Loading the Armstrong Gun, the charge and projectile, instead of being, as previously, introduced through the slot in the breech, are now passed in through the large breech-screw, which is formed hollow for the purpose,—an improvement which enables the constructor to form both the slot and the breech-piece which closes it much smaller than they would otherwise require to be.

A Breech-loading Rifled Gun (the invention of Mr. Warry) is announced, calculated, as the inventor states, to throw a ball to the distance of 5 miles.

Rapid Vertical Firing.—On the Royal Engineers' Practising-ground, Chatham, Captain Norton (3rd March ult.) exhibited an invention of his for rapid vertical firing. He takes an ordinary large-grooved rifle, which he places in a nearly upright position, with an inclination more or less slight. He then takes one of his elongated rifle-shots, weighing about 3 oz., with a percussion cartridge attached; and this being put in at the muzzle, slides down the barrel, exploding on striking the bottom. By this invention, one man may discharge about twenty shots per minute with the greatest ease, the firing being in all cases vertical and in any direction.

Exploding Military Mines by Electricity.—Experiments for ascertaining the most simple and efficacious means of attaining this strategetic object are being made at Paris.

The Imperial Guard is to be supplied, in the course of the next few weeks, with four complete batteries of the new rifled cannon. The Emperor will be present at the trial of the guns, at Versailles.

At the Royal Gun Factories in Woolwich Arsenal printed forms were (11th March ult.) delivered to the leading men and foremen, prohibiting, on pain of instant dismissal, any information to be given relative to the departments, except to naval and military officers in Her Majesty's service.

Revolvers [for Sardinia].—An urgent order from Turin reached Paris (13th March ult.), addressed to M. Lefaucheux, a large fire-arm manufacturer, for an immediate supply of 50,000 revolvers.

Large Transport or "Monster Rafts" have recently been put together on the Ticino and the Po by the Austrian Government. These "moving bridges," as they are otherwise termed, accommodate each 1,500 men, and are dragged up and down by steam-tugs.

Government Rifle Factories.—From the Parliamentary paper presented 14th March ult. (cost of public works, &c., for the year ending 31st March ult.), it appears that the saving effected on 26,488 rifles, manufactured that year under Government superintendence, was £9,385, the total cost to the Government being £74,934.

Shore Defences.—On the coasts of Illyria and of Dalmatia, Austria has, in view of the possibility of a sudden descent, ordered 70,000 earth-bags and 1,200 block-houses, or wooden forts, to be constructed, for the defence of the different parts of the shore. Each of these small forts will contain fifty soldiers.

WATER SUPPLY—(METROPOLITAN AND PROVINCIAL).

Street Fountains have been placed in Chester, in different parts of the city, at the expense of P. Eaton, Esq., an extensive brewer, and its late mayor. This supply of pure water has been found of great advantage to the working-classes in the city.

In Southampton there are to be at least two drinking fountains erected, and, in addition, two ornamental iron pumps, one of which has been, and the other is yet to be, erected in Above-Bar-street, having ladles attached.

The Madras Irrigation Company have, at last, obtained from Lord Stanley a Government guarantee.

The Bombay Copartnery, for like purposes, will now, probably, have similar privileges at once conceded to it. It is now nearly five years since this Company came into existence; and its Directors have made every effort, but in vain, to obtain a Government decision on their behalf.

In Kensington Gardens a drinking fountain has been erected, for public use; over St. Gover's Well, on the south side, between the Round Pond and the Kensington-road. The water is from a chalybeate spring, and contains, according to a recent analysis—bases: potassa, magnesia, soda, protoxide of iron, lime, and ammonia;—acids: hydrochloric, nitric, sulphuric, carbonic, and silicic.

The Serpentine, in Hyde Park, is, at last, in a fair way of being cleaned, an official announcement to that effect having (8th March ult.) been made in the House of Commons, in answer to a question on the subject.

Turin.—A large fountain was (6th March ult.) inaugurated in the Square of Carlo Felice, in this city, opposite to the Genoa railway station. The water gradually rose till it attained a height superior to that of the five-story houses that form the Square. An immense crowd witnessed the tapping of the jet, which springs from a low mound of stone blocks in the centre of an ample basin. The municipal authorities were present, and the band of the National Guard played. This fountain is the inauguration or celebration of the works of a Company for supplying Turin with drinkable water brought from a distance. It is the only fountain in that city, although there is abundance of water in the immediate vicinity of the town.

The King's Lynn Waterworks, &c. Bill passed the House of Commons 24th March ult.

The Glasgow [Corporation] Water Bill, ditto ditto.

BOILER EXPLOSIONS.

The Steam-tug "Black Eagle," which had arrived at Eastern Bute Dock to tow out the *Milo of Sunderland*, exploded at Cardiff (22nd February ult). The captain was giving some directions to the engineer, but the noise made by the steam blowing through the safety-valve, at high pressure, prevented his hearing the orders, and he put his hand upon the valve-lever to check the sound for a few moments. The pressure of the steam at this time was so enormous that even this trifling cause was sufficient to cause an explosion. Of six men on board the vessel, four were killed; the others dreadfully injured: seven persons, standing on the quay, wounded by the fragments of wood and iron, which flew about in all directions. Mr. Elliott, one of the owners, who was on board at the time of the accident, much injured.

On the Mississippi the Boiler of the Steam-boat "Princess," from Vicksburg for New Orleans, exploded, 26th February ult., at Conrad's Point, near Baton Rouge. The steamer caught fire, and burned to the water's edge. Four hundred passengers were on board at the time, 200 of whom were lost and missing, including the engineer, who was cut in two. Being behind time, he is reported to have said that he would reach New Orleans in time, or blow up. About 100 of the passengers wounded, and in a dangerous and dying state.

A Fatal Boiler Explosion, causing the death of four persons, occurred, 19th March ult., at Kelloe South Pit, about 3 miles from Durham. There are four boilers at the colliery, placed parallel to each other. Three of the four boilers were by the sudden explosion (cause still unknown) thrown from their seats, and rent in pieces, so that it is not certain, at present, in which of the three the explosion took place. The dead bodies of three men were discovered in the fire-holes; two others dreadfully scalded. The fourth death occurred on the 21st March ult.

GAS ENGINEERING—(HOME AND FOREIGN).

A Gas Explosion occurred, recently, about 12 o'clock at night, in the blast engine-house at Shott's Iron Works, whereby two men (a labourer and an engineman) were severely burned in the face, hands, and arms, while in the act of removing some gas-pipes in the above engine-house.

Another Explosion of Gas took place (evening of 1st March ult.), on the premises of Messrs. Green, Stansby, and Green, in Old Bond-street, Piccadilly. Windows of the first and second floor shattered to pieces, with other serious damage.

BRIDGES, VIADUCTS, &c.

The Bromley and Crystal Palace Railway Bridge, which crosses the main Brighton and Dover lines between the Norwood and Anerley stations, was (on the night of the 19th February ult.) discovered to be on fire. The bridge was being widened; and a large iron grate, called a "devil," filled with burning coals, was used as a light for the workmen. About midnight, the "devil" by some means got capsized, and immediately set fire to some large timbers that had been soaked in creosote, and which were intended to bear the iron girders across the bridge. The whole of the timbers, woodwork, &c., were consumed; and the new iron girders, swung ready for hoisting, became red-hot. Traffic temporarily interrupted.

London Bridge.—In the House of Commons (24th February ult.), the First Lord of the Admiralty (Sir J. Pakington), having been asked by General Codrington "whether the Board of Admiralty had given its official sanction to the construction of the permanent works" [steamer landing pier] "now being made beneath the southern arch of London Bridge," replied that he (Sir J. P.) had given his sanction to this construction as far back as March last: he had received a deputation, of which the gallant General formed part, but had not considered it necessary to interfere with the orders then given.

Lisadian Bridge, on the Monaghan and Armagh Railway, has partially fallen, in consequence of the sinking of the foundation; it is believed the whole will have to come down.

At Cork, a New Bridge is proposed to be erected in lieu of that destroyed by the flood of November, 1853. Structure, stone; arches, three. Carriage-way to be equal to entire width of the present temporary bridge, with ample footpaths; a moveable barrier to be placed in centre of carriage-way, to divide the traffic, which is increasing in this city, and prevent crowding. Estimated cost of the three-arched stone structure, £16,000. To be built by [public] tender.

The Aunacloy Bridge (over the Aunacloy River), for the Belfast and Downpatrick Line, is nearly completed; the rails having been laid over the bridge, and a steam-engine having recently passed over it.

Chelsea New Bridge.—Amount of tolls collected at this bridge from the 29th March, 1858, the day of opening, to the 8th of August in same year, when the toll was remitted on Sundays, amounted in all, according to the recent Parliamentary Return on that subject, to £2,468 19s. 10d. Amount of tolls received from that date to the 1st February in the present year, £1,787 11s.

The Bridge of Buffalora, over the Ticino, is, it appears, doomed to destruction by military law; letters from Turin (to 17th March ult.) announcing that the Austrians have commenced preparations to lay mines for blowing it up. P.S.—From Turin (20th March ult.) we learn that "the mining works which had been commenced for the purpose of blowing up the bridge of Buffalora, are stopped, but the damage already done has not been repaired."

A new Bridge over the River Irwell, near Water Street, has been decided upon by the town council of Salford. The London and North-Western Railway Company are to build the bridge complete in every respect, to carry their line of rails over the new street, the corporation of Salford paying £2,500 to remove the earth and material excavated by the Company to form the road and foundations. Total expense to the Salford corporation of the works on the Salford side, and their share of the cost of the bridge, will be £8,000. The Company to provide £3,000 towards the purchase of a street site in connection with the improvements.

Richmond Bridge is henceforth to be toll free, it having been decided, at a meeting of the Commissioners, held on the 10th March ult., Mr. Pownall, Chairman of the Middlesex Magistrates, presiding, hat, on the 25th of March (now past), the toll-bar should be removed, and the bridge thrown open for the use of the public.

THE RE-OPENING OF WEARMOUTH BRIDGE for traffic took place 19th March ult. Three tubular ribs form the arch, the span of which is 237 ft. Tubes, square, of wrought iron, 6 ft. broad and 5 ft. high, and consist of 1,284 plates, the remains of the old bridge being firmly bolted to these tubes. Height from spring of arch to roadway, 37 ft.; from crown to low-water mark, 100 ft. Tubes connected together on the top by two rows of wrought-iron plates, running their whole length, and forming a complete floor across, and on their bottom side by fifty-eight T-iron bars, at equal distances apart, and bearing a wooden floor. Six wrought-iron longitudinal girders, consisting of 768 plates, stretch from abutment to abutment. These girders are supported by 672 wrought-iron spandrils, varying in length from 30 ft. to 6 in., all firmly held together by 312 wrought-iron diagonal stays, strengthened by 116 wrought-iron tie-plates. Footpaths supported by seventy-six wrought-iron brackets, with cast-iron drops. The stone flags rest upon 156 cast-iron bearing joists. Surface of bridge covered by 316 cast-iron corrugated plates, forming the floor. Whole of wrought-iron work secured by T and angle iron, and firmly rivetted. Total number of rivets, 158,580. Whole of cast-iron work held together by screw bolts and nuts, the number of which is 8,304. The footpaths on the approaches are supported by fifty-two cast-iron brackets. Upon the corrugated plates is laid a bed of concrete, then asphalte, and, lastly, wood pavement, forming the roadway. Total weight of iron in the bridge and approaches, 900 tons. The new bridge is wider by 10 ft. than the old structure. Total cost will be about £36,000.

THE LONDONDERRY BRIDGE Bill passed the House of Commons 24th March ult.

HARBOURS, DOCKS, CANALS, &c.

THE JARROW DOCKS, on the Tyne, belonging to the North-Eastern Railway Company, were (3rd March ult.) opened for traffic by the Directors, the event being celebrated with considerable rejoicing in the harbour and town of Shields. These docks are the largest coal-docks in the north of England, and can give accommodation to 500 sail of ships at one time: 10,000 tons of coal can here be put on board vessels in one day. They will greatly relieve the harbour of Shields by making the tiers lighter, and the navigation of the river easier. The present shipping-staiths now used by the Company in Shields Harbour will be given up.

NEW DOCKS, NEAR THE MOUTH OF THE RIVER MEDWAY, are in contemplation. The site selected is the Isle of Grain, as offering superior advantages for the accommodation of the shipping trade from the northern parts of Europe. It is likewise intended to construct a line of railway from the new docks to Strood.

THE GREAT HARBOUR AT MALTA [EXTENSION, &c.].—In the new Navy Estimates is a supplementary item,—Vote No. 11. "New Works, Improvements, and Repairs in the Yards, &c., £27,000, amount required, in addition to the vote of £23,000 taken under No. 11. New Works, Repairs, &c., in Navy Estimates of 1858-59, in order to complete the purchase of property in the Great Harbour at Malta."

ROYAL DOCKS.—Vote No. 8 in the Supplementary Navy Estimates is for "Wages to artificers, &c., employed in Her Majesty's Establishments at home, £12,000 (expense of the employment of additional shipwrights and other artificers in Her Majesty's dockyards at home.

SLIPS.—There are, in the whole of Her Majesty's Dockyards, forty-two building slips: at this moment only nine of them (according to the statement of the First Lord of the Admiralty) are large enough for the construction of first-rate ships. Also thirty-three docks, of which four only in H.M.'s yards will hold our largest ships: five of them are now being increased in size.

EMPLOYÉS IN DOCKYARDS, &c.—By clause 15, in the new Reform Bill, introduced by the present Government, persons employed in dockyards, arsenals, and government yards, are disfranchised, *i.e.*, rendered incapable of voting in elections for members to be returned to parliament.

GOVERNMENT DOCK EXTENSION.—In the recent debate in the House of Commons on the state of the British Navy, Sir J. Elphinstone hoped that when we had got a good fleet, a RESPECTABLE DOCK would be provided for it. Her Majesty was worse provided with docks to fit her ships than any mercantile company in Great Britain (instancing private docks in London, Liverpool, Hartlepool, Aberdeen, &c., which he contrasted with the dock at Keyham of about 5 or 6 acres, and a miserable dock at Portsmouth; whilst there were merchant docks sufficient to accommodate 50 or 60 sail of the line.) With Cherborg staring us in the face, we ought to have a basin fit to receive 25 sail of the line at Portsmouth—(Cheers). There would be no difficulty at all about the matter—for £150,000 we could excavate a basin of 30 acres, which would contain 25 or 30 sail of the line, with barracks, a station-house, a naval college, and, in fact, an entire establishment contiguous to the present dockyards; and be able to fit ships as they were now fitted, and not as in the days of Captain Cook. So far back as the year 1780, the East India Company excavated their two large docks at Blackwall. It was time to put an end to that left-handed system of fitting our ships in the stream. He hoped the day would come when we could send a fleet out of a basin like a flock of ducks.

AT PEMBROKE ROYAL DOCKYARD, 150 hired shipwrights were (3rd March ult.) ordered to be immediately entered, with a proportionate number of joiners, blacksmiths, &c., to expedite the completion and alteration of the numerous ships on the stocks. An enlargement is contemplated towards the westward, including that space called the Penner Flats.

FROM THE SOUTHAMPTON DOCKS, during the month of February last, there were shipped for foreign ports, 39,574 packages; of which 31,404 were of general merchandise; 3,620, of specie: 3,550, baggage; and 1,000 packages mails. In same period, 8,971 packages were received in the docks, and delivered to the various companies, stores, factories, &c.—being a total number of 48,545 packages.

THE LARGE SLIP DOCK, of 2,000 tons, lately constructed in this country, under the superintendence of Messrs. Bell and Miller, civil engineers, of Glasgow, and sent out to Melbourne for the Government of Victoria, has been successfully laid down there and opened.

ANOTHER SLIP-DOCK, of 2,000 tons, has just been contracted for, to be erected at Cronstadt, for the Russian Government.

THE HAULING-UP POWER of both the above docks, is Miller's Patent Hydraulic Purchase.

AT KINGSTOWN HARBOUR [IMPROVEMENTS] Lord Colchester stated in the House of Lords (7th March ult.) that arrangements [for better accommodation for landing and embarking passengers] would be made by the Board of works in Dublin, within whose province such arrangements rested, and not with the Post-office; and that such arrangements would be made, and the landing-place completed, in about three months.

HARBOURS OF REFUGE.—The Report of the Royal Commissioners (published 10th March ult.) has been presented to Parliament. The Commissioners recommend the following places as most adapted for the construction of what in the Report are termed "LIFE HARBOURS:"—1. On the Coast of Scotland, at Wick; estimated cost, £25,000. 2. South Bay of Peterhead; cost of converting the bay into a harbour, estimated at £330,000; recommend a grant of £100,000 in aid of this work. 3. On the Irish Coast, Waterford Harbour, for a "life harbour;" recommend a grant of £50,000, for deepening the approaches. Also a grant of £40,000, for cutting down Stephen Point, between the Land's End and Hartland Point, and facilitating ingress to the harbour. A "life harbour" recommended at St. Ives, and a grant not exceeding £400,000 for its construction. At Douglas, Isle of Man, £50,000. At entrance to the Tyne, £250,000; and at Foley, £800,000.

THE NEW LANDING PIER AT LONDON BRIDGE (Surrey side), mentioned in our last, is in progress. By its means, persons who land from the steamboats will be able to pass under the bridge, and ascend on the side of the road nearest the railway, thus avoiding the dangerous crossing occasioned by the rapidly increasing traffic on the bridge.

THE "NORTHFLEET DOCKS AND LONDON QUAYS COMPANY" has been formed, with a capital of £1,500,000. Site, Northfleet, 20 miles from London, near Gravesend, and at base of chalk cliffs adjoining the Rosherville Gardens. River frontage, three-quarters of a mile; area, 14 acres; three river entrances. On east side four dry docks; one 700 ft. in length; second 425 ft.; third, 375 ft.; fourth, 325 ft. On north-east side of tidal basin will be an outlet, communicating with the great basin, 2,200 ft., or nearly half a mile in length, 700 ft. in breadth, and covering an area of 35 acres. The third basin will be the "reserve" one, 1,000 ft. by 600, with an area of about 13 acres. Estimated cost of construction of these docks, £1,307,000.

MINES, METALLURGY, &c.

THE FRASER RIVER [BRITISH COLUMBIA] GOLD FIELDS still continue to be the subject of much conflicting report. On the one hand, we hear of the miners at Bridge River, a tributary of the Fraser, being "reduced to horse-flesh, procured from the Indians at from one to one dollar and a half the pound; and, in attempting the passage down to Langley in open boats perishing from frost-bite," whilst the reverse of the picture, from apparently unbiased and trustworthy sources, presents us with a view of the operations, as at present carrying on in a tract of country extending for about 200 miles to the northward and westward of the junction of Fraser and Thompson Rivers, and including the mining country about Bridge River, as tolerably prosperous, the miners, at some places—for instance, at Fountainville—realising "10 dollars a day to the hand to 40 dollars a week to the man with ease." At Bridge River, the gold appears much given to "lie in pockets and crevices, causing great variations in the daily yield"—the gold found here being much coarser than that on the Fraser, and consisting of thin scales, quite uniform in shape, and much resembling small shot flattened out. It assays rather better than the "Fraser dust"—the Mint report giving 16 dollars 60 cents to the ounce, while the latter (Fraser) assays but 15·90—a difference which, however, is not attributed to the quality of the gold-dust itself, but to the fact that Fraser River dust, being finer, is worked with quicksilver, while the other is not.

THE CHIEF AURIFEROUS DEPOSITS, OR GOLD FIELDS OF BRITISH COLUMBIA (as at present discovered) are spread over a scope of country extending on the Fraser River from Fort Hope almost to Fort Alexander—a continuous distance of nearly 400 miles. Thompson and Bridge Rivers, tributaries of the stream, known to be auriferous—the latter as high up as 40 miles from its mouth, the former has paying auriferous bars in its bed. On Nicholas and Bonaparte Rivers (two of its confluents) gold diggings have been recently discovered. Coarse gold, recently found by some packers while exploring for a mule route around Lake Seton, on a large creek flowing into the outlet of the lake, at a point about 15 miles from the Fraser; the "dust," apparently, of high standard value. At two places on the Lillooet River, bars found that will warrant working with a sluice. The first of these, on the east side of the stream, 10 miles above Fort Douglas; the other bar 20 miles above ditto. Similar bars abundant on the Lillooet. For 100 miles above the "Pavilion" (a village on the Upper Fraser River), and beyond what is termed the Canoe Country, the banks of the Fraser have been proved to pay even better than below—the gold being coarser and more easily saved, as well as more plentiful.

BRITISH COLUMBIA [FRASER AND THOMPSON RIVER, &C.], GOLD MINES.—Most of the miners who had come down [to California] from British Columbia, expressed their determination [advices from San Francisco to January 19th ult.], to return with the advent of warm weather. Immigration (of miners, &c.), from Australia and other parts, on their way to Vancouver and British Columbia, still continued pouring into San Francisco.

A PIT ON FIRE.—Recently, at Rosehall colliery, Coalbridge, property of Messrs. Rankin and Eddie, Langloan Ironworks, some men who were working on the night shift, discovered fire from the strong smell of burning wood. On arriving at the pit bottom the burning timber was falling fast. Two of the men volunteered to ascend the pit, and give the alarm; remainder threw water from pails over the burning mass, checking it till the engine-pumps at the pit head were turned on, and water dashed down the shank. The flames, which had ascended to the mouth of the pit, gradually subsided, and by next forenoon, all danger was over. Fire originated from an iron funnel 40 fathoms long, which conveys the smoke up the pit from an engine at the bottom. Damage (including necessary renewal of pit with slides, &c., estimated at between £200 and £300.

CAGE ACCIDENT.—Recently, at No. 1 coal pit, Meadowhead, Airdrie, a collier was about to ascend the pit. Two other men were on the cage, for the purpose of ascending the shaft. They had rung the bell; and, as the cage was starting, the collier in question attempted to jump on; but, missing, was caught at the door-head. His collar bone was broken, and his body so severely bruised, that he was not expected to recover.

DURHAM COALS.—Last year about 1,267,000 tons of Durham coals were shipped from South Shields.

PIT ACCIDENT FROM GUNPOWDER.—Recently a miner, when entering a lodge at the Hall Coal and Ironstone Pit, occupied by the Shotts Iron Company, at Shotts, county of Lanark, was severely burned about the face, hands, and body, by the sudden explosion of a barrel of powder. Cause of accident not explained.

THE AUSTRALIAN MINING COMPANY have (11th March ult.) confirmed the resolution passed in July last, for stopping mining operations in the colony, with an undertaking that immediate steps shall be taken to form a new Company, for the purpose of working the mines, 30 fathoms of which have already been sunk by them, at a very considerable expense, and only a comparatively small additional sum (£2,000) being now required to test the mine.

METALLURGY.

COINING PRESSES.—At the Royal Mint, in consequence of the great demand for silver coin, seven presses are constantly engaged in stamping, and they throw off nearly a million of pieces per week. The enlarged Calcutta Mint will contain twenty-four coining presses—three times as many as the Royal Mint possesses, and will be capable of producing 600,000 coins per day.

FURNACE-FILLING.—A FATAL ACCIDENT occurred, recently, to a furnace-filler, at Summerlee Ironworks, near Glasgow. The man had ascended to the funnel-head of one of the furnaces, and in the act of stepping off the filling-machine, missed his footing, and fell a distance of 22 ft. He died in about ten minutes afterwards.

BULLION FOR COINAGE.—The gross total amount advanced from the Consolidated Fund, for the purchase of bullion for coinage at the Royal Mint, from the year 1837 to 1858 (both inclusive) was £6,133,020.

A NEW GOLD-DUST SEPARATOR is described in the "Mariposa Gazette" (California) as in successful operation at Bear Valley, on one of the estates of Col. Fremont. The principle consists in the substitution of an artificial current of air (produced by machinery) for the usual washing in water. The current is so contrived and regulated as to keep the lighter particles (of the previously pulverised quartz) suspended, the heavier or metallic ores subsiding, by their own gravity, into compartments arranged to receive them. These recipients are withdrawn in succession as the separation is accomplished, and the air-current is immediately brought to act on a fresh portion of the mixed dust. The machine is 6 ft. in height, and 4 ft. broad. The blower is so contrived as to keep up a regular and continuous current; in other words, to bring into play the differential specific gravities of a mixed cloud of dust or sand whilst suspended in a current of air instead of in a mass or current of water, at the same time avoiding an objection in the use of water separation well known to quartz washers, namely, that not only a considerable portion of the pulverised matter itself, but also of the thin gold plates, is, by the old water method, invariably washed away and lost. The machine is described as separating one ton of quartz dust per hour, extracting, according to the nature of the crushed mineral submitted to its action, all the free gold, mercury, iron, sulphurets, &c. The possibility is even hinted of its being henceforth practicable, by the aid of this new machine, to carry on mining (*i.e.*, we presume, separating) operations without the use of water.

Durability of Zinc Roofs.—The Committee of Bavarian Railways recently engaged an eminent chemist, M. Pettenkoffer, to make a series of experiments to ascertain the precise effect of the atmosphere upon zinc plates exposed to its action, with the view of determining the durability of zinc roofing. From a careful examination of some plates of zinc, which for twenty-seven years had been so exposed, it was found that, in that interval of time, the metal had become covered with a layer, consisting chiefly of oxide of zinc, carbonic acid, and water, or of hydro-carbonate of zinc, with small quantities of the oxides of iron and lead, and road dust. The chemical analysis of the hydro-carbonate of zinc showed that, in 27 years, the zinc plates had lost, by oxidation, 83·815 grains per square metre of surface, about one-half of which had been carried off by water condensed from the atmosphere. The layer of oxide does not protect the under-lying surface of the metal, the ultimate destruction of which proceeds slowly, but at a continuous and uniform pace. This gradual action, however, is by no means so prejudicial as might, at first sight, appear; for, if we suppose a layer of 83·815 grains, of which the specific weight, according to Karsten, is 6·2, to be spread over a surface of 1 metre square, this would give a layer of ·0062 mm. in twenty-seven years; and for a plate of zinc, 1 millimetre thick, to be destroyed, it would take a period of 435 years, at the end of which time the entire substance of the zinc would be converted into hydro-carbonate, and completely corroded. Practically speaking, however, zinc roofing offers no such chance of duration, inasmuch as a variety of circumstances concur to bring about a much speedier destruction, the most active of these causes of decay being the crystalline structure of the metal itself, which is attacked more or less rapidly, according to the nature of its facettes of crystallisation, so that the oxide produces, at certain points, cavities of greater or less depth. Thus, M. Lamont, with the aid of the microscope, and after having cleared, with an alkaline solution, zinc sheets from all the oxide lodged within their cavities, ascertained that the deepest of these cavities had as much as ·062 mm.—that is to say, more than 6-100ths, parts of the original thickness of the metal.

The Separation of Certain Metals, whilst in fusion, by Centrifugal Power has been recently accomplished by means of an apparatus invented by M. de Rostain. It consists in a disc of fire-clay (*terre refraetaire*) mounted on a vertical axle to which a velocity of 2,000 revolutions per minute is given: the metal, in a state of fusion, poured on to this disc, is projected laterally, in a fine shower, which becomes solidified, on cooling, before it falls down. A specimen of lead, in powder, produced in this manner, was recently laid before the (French) Society of Civil Engineers. Here, the object in view was to produce pure divided lead—*i.e.*, minutely granulated—in the most favourable state for its more economical conversion into *masticot*, or protoxide. For this purpose, it is wetted, and submitted to a moderate heat: each particle becomes covered with a skin of protoxide, which is washed off in water, the operation being frequently repeated. With the acetic acid, *ceruse* would be produced. The treatment of cast iron in fusion, by this method, has been tried with a view to its more speedy and effectual decarbonisation and purification from sulphur, phosphorus, &c., but the experiments hitherto appear to have been attended with only partial success.

An Improvement in Smiths' Forges has recently been patented by Mr. J. Thomas Howe, of Millwall, Poplar. Its merit consists principally in the substitution of cylindrical or other shaped metal air-vessels, or "blowing cylinders," moved by a lever, and sliding or moving one within the other, for the ordinary leather bellows at present in use. The invention is applicable both to portable and stationary forges, and its adoption is attended with the advantages of economy of space, increased power, and the command of an even and continuous blast.

The British and Foreign Smelting Company [Limited], incorporated on the 22nd April, 1858, ordered (5th February last) to have its affairs wound up, had its list of contributories (only eight in number), adjudicated (17th March ult.) in the Court of Bankruptcy. Liabilities of the concern, £3,367, with some assets. No opposition in any case.

APPLIED CHEMISTRY.

The "Silicating" Process for Stone [M. Szerelmey's], so as to arrest the decay visibly spreading on the external walls, has been recently tried at the new Houses of Parliament, with, it is said, complete success. An insoluble petrified substance appears to fill up the pores sufficiently to repel heat, frost, and damp; the stone itself being converted into a solid of such adamantine hardness, that no chemical agents affect it.

Printing Goods.—The Vegetable Acids [Tartaric, Citric, and Oxalic] injurious to textile fabrics. Up to the present moment it has been the general belief amongst persons engaged in the various processes of practical dyeing, &c., that the action of the organic acids was altogether devoid of injurious results on vegetable fibre; consequently, these acids have hitherto been in constant use in the preparation of colours applied to cotton. Recent carefully-conducted experiments, however, have established that this belief is an error, and that, inasmuch as the presence, however modified, of these colouring agents in the production of printed goods is unavoidably attended with danger to the texture, their use should be for the future avoided, and in their place, as far as practicable, the neutral salts substituted. The main results of the extended series of experiments alluded to show that even so small a proportion as 2 per cent. of oxalic acid attacks vegetable fibre with more intensity than does 4 per cent. of citric acid, or of the tartaric. At the temperature of 126° C. all the specimens under observation (dipped, dried in the open air, and then submitted to the action of heat) assumed a burnt or charred appearance, those impregnated with the tartaric and citric acids having a browner tint than had those impregnated with the oxalic acid. As in the process of printing goods, the oxalic, citric, and tartaric acids are respectively thickened for the purpose by means of gum or starch, &c., a series of experiments was instituted with solutions of those acids, thickened with gum and with starch; and it was found that the presence of these "thickeners" greatly increased the destructive action of the acids upon the cotton and linen, even when the proportion of gum, &c., employed did not exceed that of from 2 to 4 per cent.

At the temperatures of 80°, 100°, and 126° C., 2 per cent. of tartaric or citric acid have but feeble action on the fibres of either cotton or linen; whilst the destructive action of oxalic acid is, at these temperatures, extremely energetic, the smallest effort sufficing to tear the tissue; it is nearly equal, indeed, to that of a mineral acid.

The Difference in the Action of the Mineral Acids (diluted) on vegetable and on animal fibre, has afforded a means of detecting the fraudulent admixture of cotton and linen with woollen thread. The latter textile material resists the action of an acid which would completely destroy the two former.

A New Substitute for Coal has just been invented by an apothecary of Cologne. By his process he prepares two new substances, which he calls cialine and lignitine. They are produced from ordinary peat and lignite, or brown coal, and can replace coal and coke at a saving of 35 to 50 per cent. in price. Numerous experiments have been made with these two new products on the German railways and in factories, and, according, as it appears, to competent judges, with a satisfactory result.

A New Substitute for Gutta-Percha has lately been made known by M. Serres in a communication to the "Presse Scientifique." The "Achros Balata" is a tree growing wild in Guiana, Martinique, and the other islands of the West Indies, and its wood is used for building. The juice of the balata dried forms a light, spongy, rose-coloured mass, which crumbles when rubbed between the fingers. He has succeeded in purifying it. The substance thus obtained is more supple and elastic than gutta-percha: it softens at a higher temperature. M. Serres thinks it preferable to gutta-percha for moulding, and for covering telegraphic wires.

Sugar from Paper, Rags, Sawdust, &c. [Cellulose].—M. J. Pelouze, of the Academy of Sciences, has announced a new discovery—namely, the production of sugar from what is termed cellulose matter, derived from the chemical treatment of refuse substances of various kinds. He finds that water acidulated with either the hydrochloric, sulphuric, or some other acids, kept for a considerable time in a state of ebullition, acts in a peculiar manner upon cellulose substances, transforming them into saccharine matter. Thus paper, old linen rags, sawdust, and, in general, all cellulose matter more or less pure, is changed into *glucose* in water containing a few hundredths of its weight of acid. By heating to about 160 degrees a mixture of cellulose and caustic potash, washing the mixture, and then adding an acid, a substance having all the general characters of the "cellulose" was produced; but it was also soluble, either with or without heat, in the alkalies—a modification, in fact, of cellulose, and, by his new process, as we understand, convertible into sugar.

Metal Trade [Exports] in the first month of the last three years, compared:—

	1857.	1858.	1859.
Copper:—	cwts.	cwts.	cwts.
Foreign copper	1,980	703	3,179
English tough cake and tile	6,443	3,343	17,534
Sheets, nails, and yellow metal	24,086	19,575	24,792
Unclassified	3,031	4,936	2,991
Brass of all descriptions	1,347	2,154	2,962

Of Lead, during entire years of 1856, 1857, and 1858, the exports were respectively 23,134 tons, 22,088 tons, 19,521 tons: showing a gradual and considerable *decrease*, whilst the exports for the month of January, in each of the past three years, have been—in 1857, 1,231 tons; in 1858, 840 tons; in 1859, 1,372 tons: showing an *increase*.

ACCIDENTS FROM MACHINERY.

An Engineer (Engine-driver) employed at Smith's distillery, Thames-bank, was recently killed upon the premises. Cause of accident unaccounted for. About 5 a.m. the bell was rung by the foreman to stop the engine: no answer was given; signal repeated, but without reply. Suspicion then arose that something was wrong; and, on entering the engine-room, the mutilated remains of deceased were discovered under the fly-wheel of the engine—the head quite severed, and the brains and pieces of the skull lying about. None of the engine-work had given way or been disturbed. Verdict, "Accidental death,"—the proprietor of the distillery, in answer to questions from the coroner and jury, stating that every precaution was used to prevent accidents.

Fatal Saw-mill Accident.—At the saw-mills of Messrs. Robson and Croudace, east side of Sunderland dock (21st February ult.), a little girl was placing her father's dinner (he is a labourer at the works) as usual on the boiler, to keep warm till he came at 2 o'clock. The steam-engine was in motion, and a portion of her dress appears to have been caught by the crank of the fly-wheel, as she turned to leave the engine-house. She was pulled in below the crank to a groove in the earth made to allow the wheel to revolve, and was dreadfully lacerated. At her cries the men stopped the engine, but she was dead before she was disentangled.

Loading Revolvers.—At Clapton, parish of Mikleton, Worcestershire, a farmer was loading a six-barrel revolver pistol, when the pistol fell on the floor, causing several of the barrels to discharge, one ball blowing off his thumb and a finger, a second ball lodging in one of his thighs, while a third took off a part of his face.

LIST OF NEW PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 19th October, 1858.

2328. E. Walker, London-st.—Filter.

Dated 16th November, 1858.

2576. W. B. Johnson and J. Shepherd, Manchester—Apparatus for adjusting the permanent way of railways.

Dated 18th December, 1858.

2898. I. Ketchum, 59, Canning-st., Liverpool—Method of roasting meat, poultry, game, by basting the same.

Dated 27th December, 1858.

2960. J. Davies, Liverpool — Portable self-gas generating lamp.

Dated 1st January, 1859.

14. M. Wigzell, Friar's-green, Exeter—Form of nail or driving article.

Dated 5th January, 1859.

42. W. Corfield, jun., Charlton-Adam, Somerset—Chains for coupling cranes and cables.

Dated 8th January, 1859.

66. W. Delany, Chicago, U.S. — Submarine boats or vessels.

70. W. E. Newton, 66, Chancery-lane—Steam engines and steam generators.

Dated 14th January, 1859.

123. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Improved time-measurer.

Dated 19th January, 1859.

158. J. Thornton, Cleckheaton, Yorkshire — Carding engines.

168. J. H. Johnson, 47, Lincoln's-inn-fields — Apparatus for making cigarettes.

169. W. Clark, 53, Chancery-la.—Boots and shoes.

Dated 20th January, 1859.

175. T. Greenwood and J. Batley, Leeds—Process of gasing textile fabrics.

Dated 21st January, 1859.

196. W. H. Morrison and H. Kinsey, Nottingham—Apparatus employed in the manufacture of bonnet-fronts, ruches, and ribbon trimmings.

Dated 22nd January, 1859.

200. L. A. Drouin, 95, Rue Popincourt, Paris—Covering joinery work with metals or metallic alloys.

Dated 24th January, 1859.

222. H. Owen, Portswood, Southampton—Stockings.

Dated 29th January, 1859.

270. J. J. A. de Bronac and A. J. M. Deherypon, Paris—Improved process for treating metallic sulphurets, phosphurets, and particularly sulphuretted ores of lead, silver, and zinc.

Dated 31st January, 1859.

273. D. Bentley, Accrington, Lancashire—Self-acting apparatus, applicable to letterpress printing machines.

275. T. Wilson, Birmingham — Breech-loading and other fire-arms.

277. H. J. Newcome, Shenley, Hertfordshire—Apparatus for warming buildings.

279. A. V. Newton, 66, Chancery-lane—Method of extracting gold and silver from their ores.

Dated 1st February, 1859.

281. L. Rigolier, Lyon Place Grolier No. 5, Rhone, France —Brake for railway carriages.
283. S. B. Eveleigh, Salford—Hats or covering for the head.
284. R. Needham, Dukinfield, Chester—Water-gauge for steam boilers.
285. S. Plimsoll, 32, Hatton-garden—Mining apparatus for use in mining coal and other minerals.
287. R. Gormully, 13, Grafton-st., Fitzroy-sq.—Pianofortes with upright frames.
289. R. A. Brooman, 166, Fleet-st.—Sewing machines.
290. G. A. Waller, Dublin—Apparatus for expressing liquid from semi-fluid substances.
291. M. Loam, Treskerby-house, Truro, Cornwall—Machinery for raising sewage and other waters and matters.
293. M. Henry, 84, Fleet-st.—Application of certain bituminous products and compounds of bitumen with other matters.
295. W. E. Newton, 66, Chancery-lane—Blowing machine.

Dated 2nd February, 1859.

297. E. Wilkins, 7, Addington-pl., Camberwell, Surrey—Drain-pipes and tiles for draining.
299. F. F. Rateau, 60, Boulevart de Strasbourg, Paris—Steam-engine actuated by regenerated steam.
301. S. Tearne, Birmingham—Ornamenting surfaces.
303. I. Clements, Birmingham—Method of manufacturing curtain-rings.
305. G. Leach, Leeds—Leashing yarn or thread in the hank.

Dated 3rd February, 1859.

307. T. Storer, Birmingham—Improved funeral carriage.
308. J. Woodrow, Oldham—Hats or covering for the head.
309. W. Clayton and J. Goodfellow, Blackburn—Metallic pistons.
310. H. C. Jennings, 8, Great Tower-st.—Manufacture of paper and artificial parchment.
311. J. Petrie, jun., Rochdale, and T. Wrigley, Heapbridge, Lancashire—Apparatus for washing rags.
312. S. D. Davison, Leith—Locomotive steam-engines.
313. A. G. Pooley, Globe Wharf, Rotherhithe—Preparing fish for manure.

Dated 4th February, 1859.

314. M. Smith, Sun Foundry, Heywood, Lancashire — —Looms for weaving.
315. H. Greaves, 5, Victoria-st., Westminster — Preparation of iron bars.
316. W. Thompson, 2, Rue Sainte Appoline, Paris—Printing telegraph.
317. A. Allan, Perth—Locomotive steam-engines.
319. S. L. Trotman, Liverpool — Fastening envelopes or other like receptacles.
320. R. A. Brocman, 166, Fleet-st. — Cooling worts and beer.
321. R. A. Brooman, 166, Fleet-st.—Shirts.
322. G. H. Baylis, 13, Vauxhall-walk, Lambeth, and F. Robinson, 88, Salisbury-st., Lisson-grove — Indicator for registering the withdrawal of liquids from vessels.
323. F. H. Maberly, Stowmarket, Suffolk — Obtaining spring power.
324. L. Bonneau, 279, Rue Saint Denis, Paris—Apparatus for registering the time carriages are employed in conveying persons from place to place.
326. P. Adie, Strand — Apparatus for taking levels and measuring angles.
327. W. R. J. Packer, 4, Leinster-st., Dublin—Plough or plough-share.
328. J. Honeyman, Glasgow—Construction of ships, vessels, and boats.
329. A. Barclay, Kilmarnock, Ayr, N.B.—Electric-magnetic or electro-magnetic telegraph ropes or conductors.
330. W. Clark, 53, Chancery-la.—Apparatus for preserving grain, eggs, and other vegetable and animal substances.

Dated 5th February, 1859.

331. F. H. Maberly, Stowmarket, Suffolk—Apparatus for drawing corks.
332. N. Greenhalgh, W. Shaw, and J. Mallison, jun., Bolton, Lancashire—Preparation of yarns or threads previously to dyeing.
333. R. Tinkler, Penrith, Cumberland—Churns.
334. H. Anderson, Liverpool—Apparatus for winding window blinds.
335. T. Sykes and B. C. Sykes, Cleckheaton, Yorkshire—Separating oily, fatty, greasy, tarry, waxy, and resinous substances from oleaginous seeds, nuts and fruits, wool, silk, and other animal matters and refuse, woollen and cotton waste.
336. T. R. Ayerst, Newenden, Kent—Breech-loading guns and other fire-arms.
337. M. Booth, Manchester, and J. Farmer, Salford—Stiffening woven fabrics.

Dated 7th February, 1859.

338. G. F. Chantrell, Liverpool—Treatment of charcoal.
339. J. Holroyd, Leeds — Apparatus used in finishing woollen and other cloths.
340. A. Lyons, 77, Chancery-lane—A pocket protector.
341. W. H. Crispin, Marsh-gate-lane, Stratford, Essex—Hydraulic engine for sailing and steam vessels.
342. M. Curtis, Manchester, and J. Miller, Staley Bridge, Lancashire—Certain mules for spinning cotton and other fibrous substances.
343. J. Lee, 18, Monson-st., Lincoln — Manufacture of cranks for steam engines and other purposes.
344. T. Sims, Conduit-st., Regent-st. — Application of photography to engraving and printing.
345. E. T. Hughes, 123, Chancery-la.—Ovens.
346. J. Smith, Bradford—Apparatus for preparing and combing wool.
347. J. Wilson, 55, John-st., Sunderland — Ventilating mines.

Dated 8th February, 1859.

348. T. Moss, 69, Fleet-st. — Manufacture of paper and printing ink, suitable for bank-notes and other documents.
349. E. T. Hughes, 123, Chancery-la.—Apparatus for sorting and numbering the threads or filaments of silk or other fibrous materials.
351. G. Thomas, 47, Hamilton-st., Paddington—A double-bottomed horse-shoe.
352. D. E. Bagnicki, New York—Syringing apparatus for curing leucorrhea.
353. W. Waller, Chesterfield, Derby—Agricultural or farm implements or apparatus.
354. R. R. Rowntree, Kingston-upon-Hull—A portable tea testing apparatus.
355. J. Aspinall, Great Tower-st.—Refining of sugar.
356. J. B. Redman, New Palace-yard, Westminster—Construction of carriage-ways.
357. A. Clark, Gate-st., Lincoln's-inn—Revolving shutters and blinds.
358. W. Clark, 53, Chancery-lane—Improved protectors for tobacco plants.
359. T. S. Cressey, High-st., Homerton—Machinery used in the manufacture of casks.
360. J. Juckes, Dame-st., Wharf-rd., City-rd., Islington—Stoves or fireplaces.

Dated 9th February, 1859.

361. E. Wilkins, 7, Addington-pl., Camberwell-rd.—Flower vases.
362. J. S. Joseph, Rhostyllan, near Wrexham, Denbigh, North Wales—Coke ovens.
363. W. Archer, Bolton—Jacquard machines.
364. H. Jefferies, Birmingham—Castors.
365. J. Crossley, Halifax—Steaming printed yarns.
366. J. Taylor, Stalybridge, and C. Wild, Oldham—Self-acting mules for spinning and doubling.
367. J. H. Johnson, 47, Lincoln's-inn-fields—Fire-arms.
368. G. Bower, St. Neot's, Huntingdonshire—Apparatus for the manufacture of illuminating gas.
369. J. E. McConnell, Welverton — Steam boilers and treatment of steam.
370. W. E. Newton, 66, Chancery-la. — Bleaching and purifying.
371. E. Herring, the Heath, Weybridge, Surrey—Mashing and fermenting of grain for the production of alcohol.
372. W. E. Newton, 66, Chancery-la. — Breech-loading fire-arms.

Dated 10th February, 1859.

373. H. P. Burt, Charlotte-row, Mansion House—Railway carriages and waggons.
374. J. Young, Wolverhampton—Construction of knobs, and the roses used for connecting knobs with doors.
375. J. G. Taylor, Paris—Writing materials, and the manufacture thereof.
376. W. A. Covert, Long Island, New York—Self-acting railway switch.
377. R. J. Ellis, Liverpool—Apparatus for lifting sunken vessels and other submerged bodies.
378. G. L. Stocks, Bridge-road, Poplar—Steering apparatuses.
379. H. Inger, 3, Red Lion-sq., Holborn—Blinkers used by horses whilst drawing, to be called the "Patent Safety Blinker."
380. B. Burrows, Leicester—Looms for weaving narrow fabrics.
381. C. L. Perry, Sheepstead Farm, Marcham, Berkshire—An agricultural implement for paring and ploughing land.

Dated 11th February, 1859.

382. M. Billing, Birmingham, and W. Kloen, Aston, near Birmingham—Apparatus for decolorizing tea.
383. J. Evans, Tarlton-st., Liverpool—An improvement in "Hansom" cabs.
384. J. Parkinson, Manchester—Coffins.
385. N. Bennett, 4, Furnival's-inn—Construction of brooms or brushes for sweeping or cleansing streets.
386. H. Bruce, Kinleith Mill, Currie, Midlothian, N.B.—Apparatus for the manufacture of paper.
387. G. Hyde, 61, Fleet-st.—A pen for producing a copy or copies of a letter or other writing simultaneously with the production of the original.
388. R. Cogan, Red Lion-sq.—Instruments for crushing and mixing solid and liquid substances.
389. H. A. Bartlett, Thetford, Suffolk—Machinery to be used with or without the plough for clearing and cleaning land from weeds.
390. C. Jackson, Store st., Bedford-sq.—Action of pianofortes.
391. J. Grimes, 6, Osborn-st., Whitechapel—Beer engines.
392. H. Ransford, West Brompton—Building ships and other vessels.

Dated 12th February, 1859.

393. G. Hadwen, Audenshaw, and J. Wadsworth, Droylsden, Lancashire—Jacquard apparatus.
394. H. Lea, Birmingham—Changing or reversing motion.
395. T. Willis and G. Chell, Longsight, near Manchester—Machinery for spinning and winding yarns.
396. C. R. Moate, 65, Old Broad-st.—Manufacture of nuts, screws, and other headed fastenings.
397. J. Crabtree, Market-st., Bradford—Manufacture of bobbins and spools.
398. S. H. Huntly, Upper Baker-st.—Cooking apparatus.
399. T. White and G. Jenkins, Portsmouth—Apparatus for raising and lowering ships along inclined slips.
400. J. Bennett and J. Bennett, Kingsland-rd.—Refrigerators for cooling beer and worts.
401. G. Betjemann, G. W. Betjemann, and J. Betjemann, Upper Ashby-st.—Book-slides.
402. W. G. Rawbone, Gloucester-st.—Fire-arms and ordnance.
403. G. T. Bousfield, Loughborough-park, Brixton—Revivifying the scarlet colour of woollen cloth lace and embroidery, in use for military and other garments and furniture.
404. H. Gardner, 1, Old Quebec-st., Portman-sq.—Machinery for breaking and preparing flax and other fibres.
405. R. Bell, Paris—Separating and recovering wool from fabrics composed of wool, or wool in connexion with cotton.
406. W. E. Newton, 66, Chancery-la.—Breech-loading fire-arms.
407. W. E. Newton, 66, Chancery-la.—Sewing machines.

Dated 14th February, 1859.

408. J. Parkinson, Manchester—Coffins.
409. T. Hunt, Crewe, Chester—Steam boilers or generators.
410. C. Sanders, Harford-st., Birmingham—Ornamenting English passepartouts for photographic pictures.
411. J. Wright, New George-st., Sheffield—Reducing and rolling steel and iron wire.
412. J. L. Clark, Haverstock-hill—Means of working railway signals and switches.
413. J. Copcutt, 26, Kirby-st., Hatton-garden—Obtaining light from gases.
414. R. Clegg, Islington, F. Angerstein, Kennington, and J. W. Page, Walworth-rd.—Making soap.
415. A. B. Clarke, Edward-st., Blackfriars-rd.—Discharging sewage and water from lands into tidal rivers.

Dated 15th February, 1859.

416. E. H. Aldrich, Shoreditch—Ladies' dress caps.
417. C. L. Roberts, Clerkenwell—Improved cigar.
418. R. Mushet, Coleford, Gloucestershire—Manufacture of steel iron and cast steel.
419. F. Walters, Sheffield—Application of the waste heat, from puddling furnaces.
420. W. Raymond, 4, Albion-sq., Dalston—An improved life-raft.
421. J. Paterson, Wood-st.—Brace buckles and loops.
422. J. T. Jones, Glasgow—Sewing machines.
423. G. Bedson, Manchester—Joining wire for telegraphic and other purposes.

Dated 16th February, 1859.

424. J. F. Tourrier, 41, Manchester-st., Manchester-sq.—Preventing oscillation of the last carriage of a railway train.
425. M. Crawford, Liverpool—Anti-fouling metallic varnish.
426. S. Bailey, Wednesbury, Staffordshire—Apparatus for preventing the skip in mine operations being pulled over the pulley on which the rope or chain works to which such skip or cage may be attached.
427. R. Cookson, Layton Hawes, near Blackpool, Lancashire, and C. W. Homer, Castle-hill, near Northwich, Chester—Machinery for making bricks, tiles, and other articles of plastic materials.
428. C. E. Wright, Nottingham—Apparatus employed in the nursing or treatment of infants.
429. R. J. S. Pearce, Fleet-st.—Weighing and dynamic machines.
430. P. M. P. Boujeard, Davies-st., Middlesex—Apparatus for supporting the womb.
431. W. E. Newton, 66, Chancery-la.—Mowing machine or grass harvester
432. A. V. Newton, 66, Chancery-la.—Construction of brushes.
433. W. E. Newton, 66, Chancery-la. — Machinery for making bricks.
434. W. H. Horstmann, New York—Telegraphic cables.
435. J. J. Russell, Wednesbury, Staffordshire—Machinery used for heating and welding the edges of the plates used in the manufacture of cylinders and other articles.
436. W. A. O'Doherty, 5, Eastcheap—Black lead pencils and pencil cases.
437. J. Seguin, 4 Grande Rue de Gravelle à St. Maurice (Seine), France — Employment of moving power arising from the tides.
438. J. S. Benson, Birmingham—Improved method of silvering glass.
439. J. Breeden, Birmingham—Machinery for the manufacture of taps or stopcocks.
440. J. Eason, Oxford-st.—Apparatus applicable to tanning, dyeing, and obtaining extracts from vegetable and mineral substances.

Dated 17th February, 1859.

441. S. T. Cooper, Upper Clapton—Use and application of artificial light.
443. Capt. H. Y. D. Scott, R.E., Brompton Barracks, Chatham—Manufacture of cement.
444. B. Saillard, Lamb's Conduit-st.—Mode of obtaining printing plates from collodion pictures.

445. P. E. Fraissinet, Paris—Improved structure of iron, applicable for paving, flooring, and other like purposes.
446. T. Cattell, 30, Euston-sq.—Treating and purifying gutta percha.
447. F. W. Emerson, New Charlton, Kent—Treatment of certain ores of lead.
448. C. Fay, Manchester—Apparatus for working railway breaks.
449. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for propelling and steering vessels and other floating craft.

Dated 18th February, 1859.

450. J. J. Cole, 24, Essex-st., Strand—Venetian and other suspended blinds.
451. C. Garton, Bristol—Method of treating cane sugar.
452. H. Swaisland, 54, Great Sutton-st., Clerkenwell—Box sextants.
453. G. Wallis, Stretton, near Penkridge, Staffordshire—Improved method of engraving, applicable to the production of printing surfaces.
454. G. Kammerer, Lombard-st.—Gearing for gins of horse-mills.
455. W. Clark, 53, Chancery-la.—Emptying cesspools.
456. W. Clark, 53, Chancery-la.—Pressure gauges.
457. J. H. Johnson, 47, Lincoln's-inn-fields—Manufacture of textile fabrics.

Dated 19th February, 1859.

458. P. A. J. Dujardin, Lill, France—Printing apparatus of railway telegraphs.
459. A. R. Le Mire de Normandy, 67, Judd-st., Brunswick-sq.—Apparatus for obtaining fresh water from salt water.
461. W. Clay, Liverpool—Manufacture of deck and other beams, and of angular and other bars of various forms.
463. S. Wheatcroft, Brudenell-pl., New North-rd.—Uniting lace to blond and other fabrics.
464. C. F. Vasserot, 45, Essex-st., Strand—Manufacturing the strands of wire ropes.
465. C. F. Vasserot, 45, Essex-st., Strand — Carding machine.
466. R. A. Brooman, 166, Fleet-st.—Machinery for doubling threads.
467. F. P. J. Van den Ouwelant, Paris—Apparatuses to be applied to fire places for obtaining a more complete combustion of the fuel employed therein.

Dated 21st February, 1859.

468. G. Paul, Glasgow—Spindles and flyers.
469. O. Blake, Blackwall—Apparatus used in the manufacture of glass.
470. G. McCulloch, Manchester—Apparatus for spinning, doubling, and throwing silk.
471. T. Wilson, Birmingham—Manufacture and construction of ordnance.
472. A. Belpaire, Brussels—Reversing gear of locomotives and other steam engines.
473. G. Humphrey, Deptford, Kent—Meters for measuring fluids and gases.
475. R. Jobson, Wordsley, Staffordshire—Supplying water or other fluid to axletree boxes and other journal bearings, to lubricate the same.
476. A. Taperell, 37, Moorgate-st.—Compounds used for cleaning glass.
477. R. W. Johnson and W. Stableford, Oldbury, Worcestershire—Axle boxes.
478. J. Schloss, Cannon-st.—Locks or clasps for portemonnaies, bags, and other like purposes.

Dated 22nd February, 1859.

479. T. Smith, Chatteris, Cambridgeshire—Floating wheels for driving machinery.
480. W. Soleman, 3, Bennett st., Middlesex—Construction of propellers.
481. J. Grimond, Manchester—Treatment and preparation of jute and other fibrous materials.
482. J. Curtis, Drury-la.—Manufacture of military sash net.
484. J. Hine, Clerkenwell—Book slide.
485. E. Lund, Manchester—Manufacture of fabrics or textures to be used in the construction of umbrellas and parasols.
486. R. A. Brooman, 166, Fleet-st—Method of fixing tanning upon textile fibres.
487. T. R. Harding, Leeds—Manufacture of card surfaces to be used in preparing fibrous materials.
488. W. Gossage, Widnes, Lancashire—Utilization of alkali waste.

Dated 23rd February, 1859.

489. A. W. Smethurst, Chorley, Lancashire—Machinery for driving looms for weaving.
490. S. Ridge, Hyde, Chester—Coupling or making the joints of pipes and other articles.
491. W. Ashton, Heaton Norris, Lancashire—Gas regulators.
492. G. Davies, 1 Serle-st., Lincoln's-inn—Apparatus applicable to the evaporation of saccharine liquids.
493. U. Scott, Camden-town—Carriages.
494. W. Sharp, Bingley, Yorkshire—Machinery for spinning and twisting worsted and other fibrous materials.
495. S. Samuels, Nottingham—Twist lace machines.
496. S. Russell, 12, Sheaf-gardens, Sheffield—Manufacture of handles for tea and coffee pots, knives, daggers, and forks.
497. G. Turnbull, Calcutta—Permanent way of railways.

Dated 24th February, 1859.

499. J. Robinson, Lower House, near Burnley, Lancashire—Apparatus applicable to machinery for spinning and doubling.
500. R. Mushet, Coleford, Gloucestershire—Metallic compound or alloy.
501. R. Mushet, Coleford, Gloucestershire—Manufacture of cast steel.
502. J. Holms, Glasgow—Apparatus for propelling vessels, ships, and boats.
503. J. Crosland, Crosland-moor, Huddersfield—Looms for weaving textile fabrics.
504. A. Lançon, jun., Besançon, département du Doubs, France—A new system of watches.
505. J. H. G. D. Wagner, Paris—Apparatus for cleaning water.
506. J. Dale, Cornbrook, Manchester — Concentrating caustic alkalies.
507. E. Price and E. Hawkins, Doncaster—Mode of forming fish plates.
508. A. C. Kelly, Silchester-road, Notting-hill—Apparatus for drawing off fluids.

Dated 25th February, 1859.

509. A. Reid and R. Tonge, Manchester—Weaving.
510. A. Reid and R. Tonge, Manchester — Looms for weaving.
511. T. C. Hinde, Dudley, Worcestershire, and G. J. Hinde, Wolverhampton, Staffordshire—Coating iron with copper or alloys of copper.
512. C. W. Siemens, John-st. Adelphi—Electric telegraphic line wires.
513. W. McNaught, Manchester—Steam engines.
514. R. Fielden, jun., and T. Fielden, Walsden, Lancashire Manufacture of pickers to be used in looms for weaving.
515. J. Reddie, Colehill-lodge, Fulham, Middlesex—Mode of propelling and steering vessels.
517. W. Clark, 53, Chancery-lane—Apparatus for spinning and drawing fibrous materials.

Dated 26th February, 1859.

518. F. Weekes, Bolney, Sussex—The treatment of certain alcoholic products.
519. G. Earnshaw, Horbury, near Wakefield—The treatment of woollen substances, so as to obtain useful products therefrom.
520. J. Lee, Saint Helen's, Lancashire—Ploughs.
521. J. Hine, Clerkenwell—Joint for cabinet making.
522. W. Burgess, Newgate-st. — Reaping and mowing machines.

Dated 28th February, 1859.

523. E. Gatwood, Great George-st., Westminster—Buffing traction and bearing springs.
525. A. Martin and A. Crichton, Pollokshaws, Renfrew Weaving and woven goods.
526. J. Howden, Glasgow—Apparatus for cutting, shaping, and compressing metals.
527. J. Leigh, Manchester—Purification of coal gas.
528. G. Horner, Falls-rd., Belfast—Hackling flax, and other fibrous materials.
529. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for stopping horses.
530. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for taking soundings.
531. C. Hall and C. Hall, jun., Navestock, Essex—Steam agricultural machinery.
532. A. Turner, Leicester—Manufacture of elastic fabrics.
533. A. V. Newton, 66, Chancery-lane—Constructing and working condensing engines.
534. W. Hodson, Kingston-sq., Hull—Rotary engines.
535. R. Brown, Earith, near Saint Ives, Huntingdonshire, and W. Milne, Bushey, Hertfordshire—Firearms.

Dated 1st March, 1859.

537. T. Cloake, 6, Saville-row, Walworth, Surrey—Stopping of the bodies and wheels of railway and other carriages.
538. J. Holroyd, Leeds—Finishing woollen cloths.
539. Rev. H. Moule, Fordington, Dorsetshire—Apparatus applicable to the evaporation of sewage or other waters.
540. J. Wetherilt, Chapel-st. west, Mayfair, Middlesex — Locks.
541. J. Edwards, Fenton, Staffordshire—Stacking or holding biscuit, china, and glossed ware for firing.
542. G. P. Rivers, Baron Rivers, Rushmore-lodge, Wiltshire—Implement for breaking up and preparing land.
543. J. Templeman, Glasgow—Production of artificial fuel.
544. J. Pile, West Hartlepool — Construction of floating docks.
545. D. Lichtenstadt, 1, Henry-cottages, Park-rd., Peckham — Converting vegetable substances into fibrous material.

Dated 2nd March, 1859.

547. P. Currie, Birmingham—Spindles for locks.
548. J. Valda, London—Studs and other like fastenings for dresses.
549. J. M. Adams, D. Law, and J. Inglis, Glasgow—Fire-places and stoves.
550. R. H. Collyer, Alpha-road, Middlesex — Preparing materials for the manufacture of paper.
551. W. F. Dearlove, 10, Dartmouth-st., Westminster—Chopping machine.
552. F. J. Jones, Aldermanbury—Buckles and clasps.
553. J. W. Harker, 24, Upper Barnsbury-st., Islington, and K. Field, Upper Marsh, Lambeth — Coating the bottoms of iron and other ships and vessels.
554. E. Roche, Marseille, France—Manufacture of paper suitable for forming cigarettes.
555. C. Hill, Cheddar, Somersetshire—Construction of stay fastenings.
556. W. E. Newton, 66, Chancery-la. — Construction of barometers.
557. J. H. Johnson, 47, Lincoln's-inn-fields—Construction of grease boxes and bearings generally.
558. J. Kershaw, Allerton, near Bradford, Yorkshire—Apparatus employed in weaving.
559. J. Newcomb and J. G. Lovell, Bristol – Obtaining and applying motive power.
560. H. Brown, Galashiels, Selkirk, Scotland—Machinery for cutting and finishing the surfaces of woollen fabrics.
561. W. Brown, 4 and 5, Edgar-place, Mile-end—Manufacture of pipe mounts or stems, cigar tubes, and similar articles.

Dated 3rd March, 1859.

562. H. Kohn, 5, North-pl. Gray's-inn-road—Articles of wearing apparel called coats.
563. J. Harrison, Bermondsey, Southwark—Construction of rotating window sashes.
564. T. Wilson, Birmingham—Breech-loading fire-arms.
565. A. W. Hale, New Britain, U.S.—Improved machine for cutting or mincing meat, vegetables, &c.
566. J. D. Dougall, Glasgow—Fire-arms.
567. W. Jackson, Colne, Lancashire—Shuttles for looms.
568. W. Score, 9, Osborne-ter. Clapham-rd.—Manufacture of soap.
571. T. Cook, Stowmarket, Suffolk—Raising and lowering coffins and bodies.

Dated 4th March, 1859.

573. C. F. Dennet, Pall-mall—Bayonets.
574. M. Rider, Todmorden, Yorkshire—Machines for preparing, spinning, and doubling cotton.
575. J. Cowban and E. Andrews, Burnley, Lancashire—Apparatus for spinning fibrous materials,
576. R. A. Brooman, 166, Fleet-st.—Boiler stays.
577. C. R. Mead, 176, Great Dover-st. Southwark—Water gas-meters.

Dated 5th March, 1859.

578. W. Bailes and J. Bailes, 434, Oxford-st.—An improved ship's berth for prevention of sea sickness.
579. J. M. Dunlop, Manchester—Apparatus for cleaning fibrous materials.
580. J. Leigh, Manchester—Purification of coal gas.
581. J. Fraser, Banff, N.B.—Ploughs.
582. F. W. Parker, Sheffield—Sewing machines.
583. E. Vigers, Paddington — Construction of ships and other vessels.
584. W. P. Savage, Roxham, Downham Market—Machine for excavating, raising, and depositing soil.
585. F. Verdeil, 30, Rue St. Sulpice, Paris, and E. Michel, 4, Quai Imperial, Puteaux, Seine—Treating madder.
586. G. Leach, Leeds—Machinery for reeling and leashing yarn or thread.
587. F. Morton, James-st., Liverpool — Construction of strained fences.

Dated 6th March, 1859.

589. H. W. Patrick, 4, Mill Hill-terrace, Acton—Apparatus for chemical and dental laboratories.
590. D. Proudfoot, Glasgow—Turkey-red dyeing.
591. A. Cabany, Anzin, Nord, France—A new system of quoins (wedges) for railways.
592. W. Palmer, Long Eaton, Derbyshire——An improved railway carriage break.
593. F. Ayckbourn, 27, Henry-st., Vauxhall-gardens — Laminating india-rubber cloths with paper sheets.
594. W. Gossage, Widnes, Lancashire—Treatment of certain ores of copper for the extraction of metal therefrom.
595. J. Aspinall, Great Tower-st.—Evaporating in vacuo.
596. P. E. Aimont, Paris—Construction of wagons and other carriages for railways and ordinary roads
597. J. Orr, 31, South Albion-st., Glasgow—Weaving ornamental fabrics.
598. J. P. Clarke, King-street mills, Leicester—Manufacture of reels for the winding on cotton, linen, or other fibrous materials.
599. J. L. Jullion and G. Pirie, Stoneywood Works, Aberdeen—Manufacture of gelatine.

Dated 8th March, 1859.

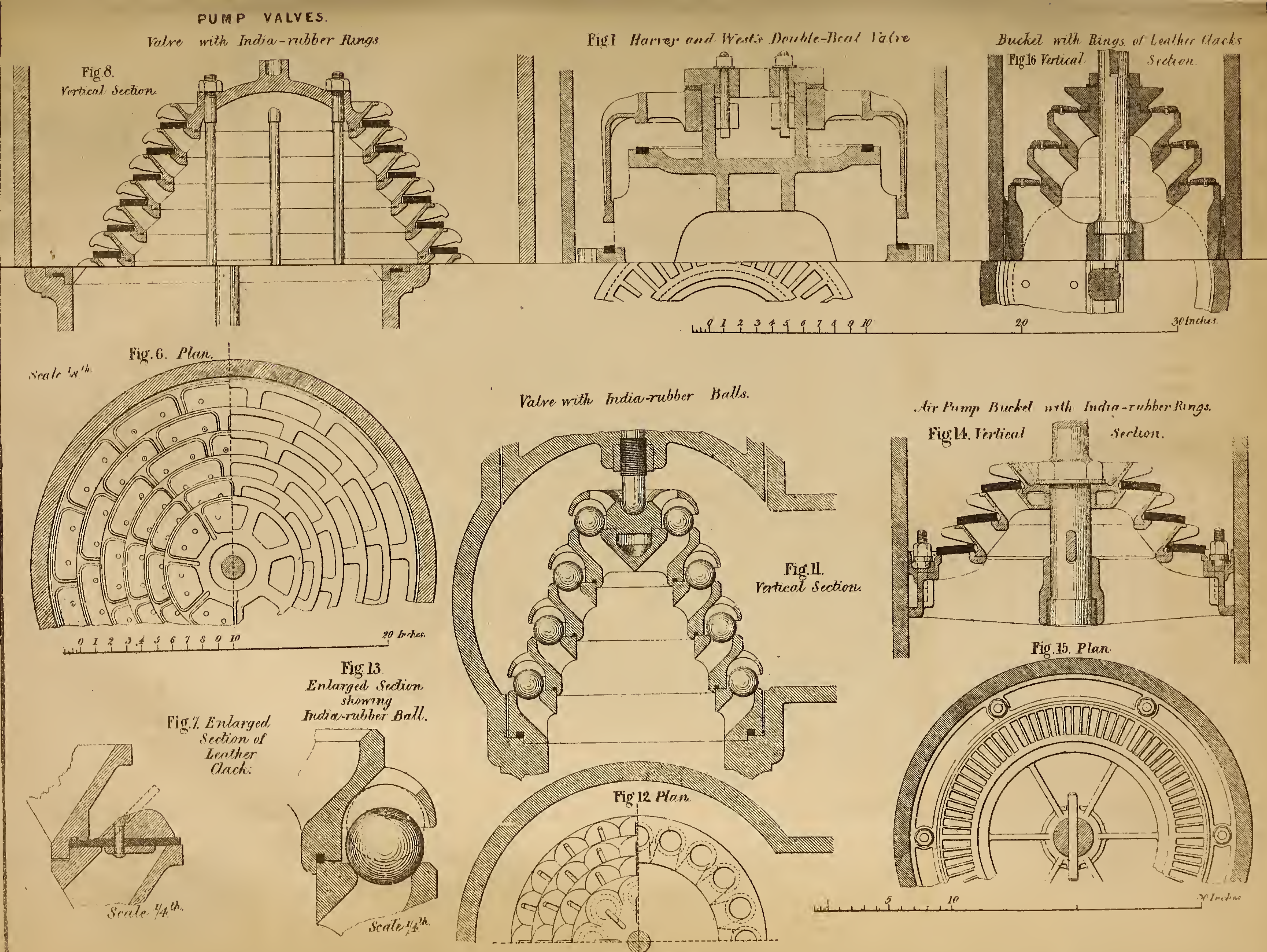
601. A. Booth, sen., and A. Booth, jun., Manchester—Apparatus for making and manufacturing tags for laces.
603. G. Twigg, Birmingham—Improved fusee-igniter for the use of smokers.
605. J. N. Ryder, Bexley-heath, Kent—Preserving fruits.
607. W. Clark, 53, Chancery-la.—Submarine telegraph cables.

INVENTIONS WITH COMPLETE SPECIFICATION FILED.

483. W. S. Clark, 76, Cannon-st. West—Formation of cast-iron rails for city railways, and also in the method of uniting the ends of two adjacent rails for railway use.—22nd February, 1859.
584. F. Bignoles, 3, Duke-st., Adelphi—The disinfection and rectification of alcohols, by the separation of the essential and other oils from the alcohol.
628. N. Washbourn, Massachusetts, U.S.—A new and useful or improved machine for rolling tires for wheels 11th March, 1859.

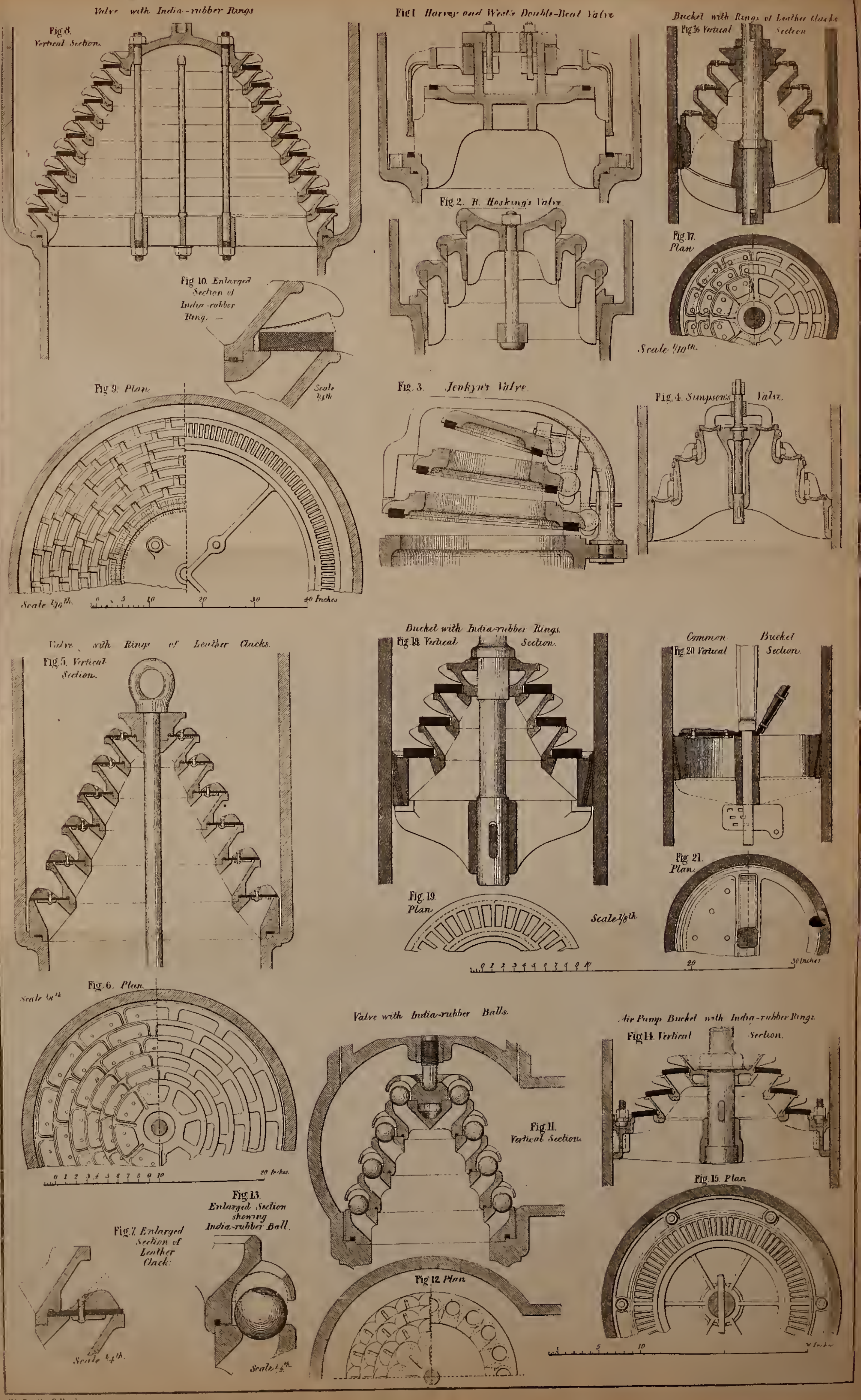
DESIGNS FOR ARTICLES OF UTILITY.

4149. Jan. 25. Elias Lyons and Sons, the Peasley Glass Bottle Works, Sutton, St. Helen's, "Glass Bottle."
4150. Feb. 9. William and John Sangster, 75, Cheapside, "Parasol."
4151. ,, 14. John Whitehouse and Son, Birchall-st., Birmingham, "A Bolt or Fastener."



W. Smith, C.E., direx.

PUMP VALVES.



W. Smith, C.E., direx.

LOCOMOTIVE ENGINE SHED.

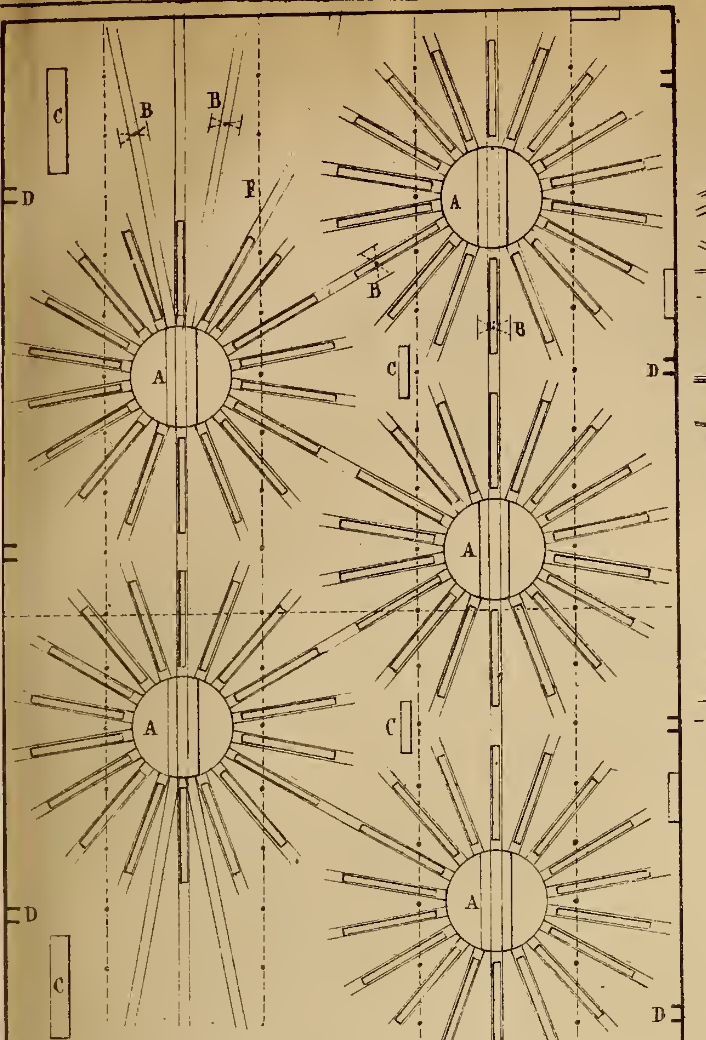


Fig. 1. Plan of Engine Shed.

Fig. 3 Transverse Section of Centre Roof.

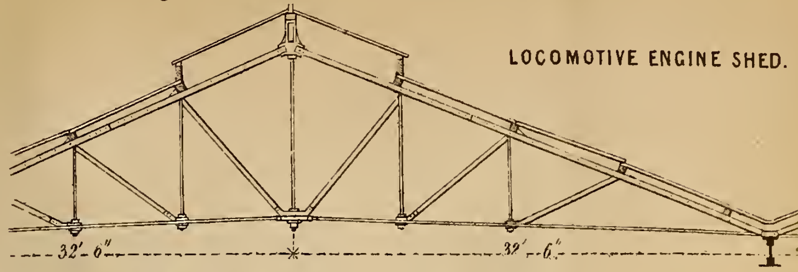


Fig. 4. Elevation of Long Girder

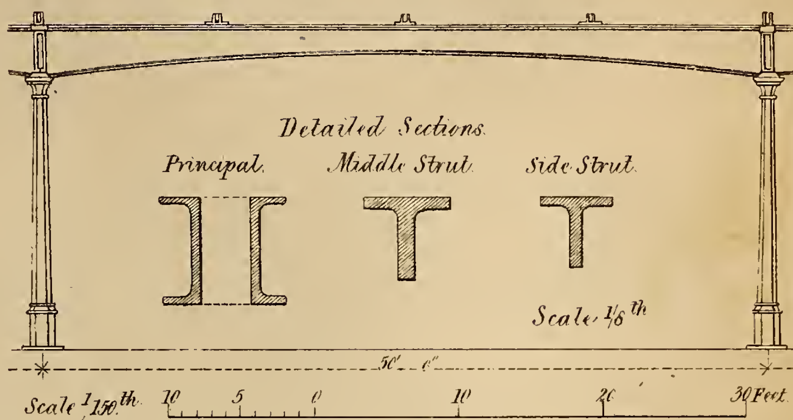


Fig. 6. Plan of Engine Turntable.

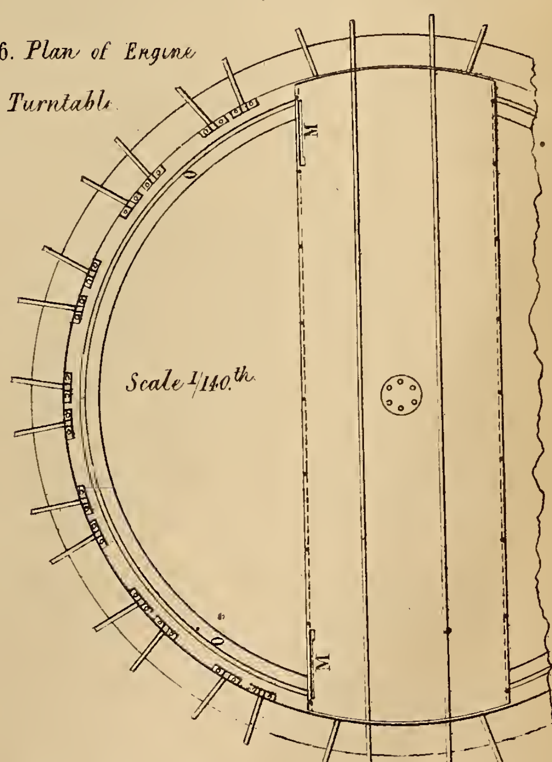


Fig. 2. Transverse Section.

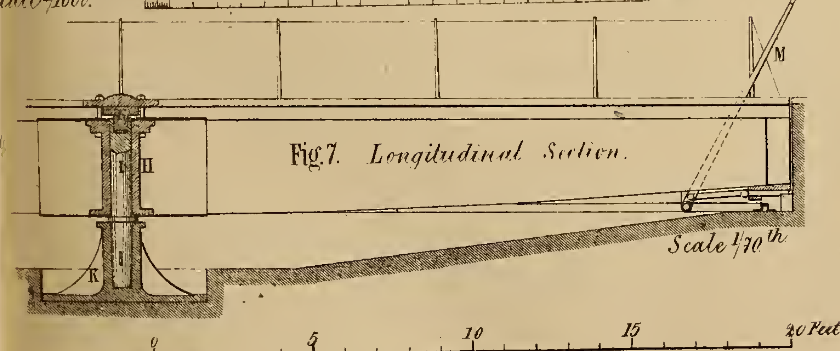


Fig. 7. Longitudinal Section.

Fig. 8 Transverse Section at centre.

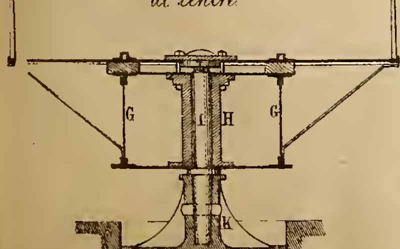
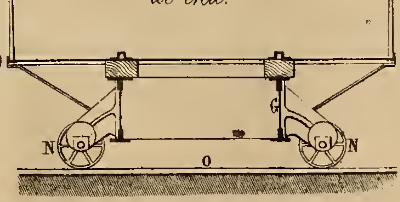
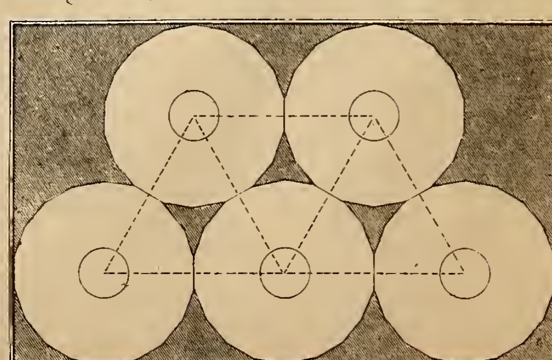


Fig. 9 Transverse Section at end.



Scale 1/70th

Fig. 5. Diagram of General Plan. Scale 1/2000th



W. Smith, C.E., direx.

THE ARTIZAN.

No. 196.—Vol. 17.—MAY 1st, 1859.

STEAM ENGINEERING IN 1859.

INTRODUCTORY.

No apology is required for calling attention to the present state of steam engineering, especially when it is a well-known fact that, at no previous period has there been a greater spirit of inquiry respecting the duty that should be realised from the steam-engine than at the present time; indeed, it may be said, that among engineers themselves, there is a decided feeling of dissatisfaction on this point.

The following observations are entirely of a general character, preparatory to a consideration of details, and they are intended to refer to what *has been* done, what *is being* done, and what can be done; also, how far the present state of steam engineering will compare with the days and deeds of Watt, after crediting him with the mechanical improvements of nearly a century.

In 1769, James Watt specified his three great inventions:—separate condenser; encasing the working cylinder with steam or other source of heat, to prevent premature condensation; and employing the expansive action of steam.

The title of this specification was, "A Method for Lessening the Consumption of Fuel in Fire-engines." The inventions were not merely mechanical improvements, but they were the development of the principle on which Watt based all his hopes of economy—namely, that HEAT IS THE SOURCE OF ALL POWER IN STEAM; and his aim was to prevent all needless and premature condensation, and consequent loss of power.

His correspondence also, and the nature of the inventions referred to, prove his belief that heat is the mainspring of the steam-engine. The truth and correctness of that belief have been fully manifest in the experience of the period that has elapsed since 1769.

Previous to Watt's inventions, when, in Newcomen's engines, the condenser was the working cylinder itself, the waste heat in this defective system amounted to more than three-fourths of the total steam generated; and when to that waste were added other losses incidental to the generation and working of the steam in a defective machine, the result realised was a mere fraction of the power represented in the combustion of the fuel.

Watt's first invention of the separate condenser lessened the waste condensation to a great extent; his second invention of encasing the working cylinder with steam, &c., was only an extended application of the principle of the first; and his third invention of using the expansive action of steam, could only be applied with success in combination with the other two: indeed, they are such a united trio that, in condensing engines, neither can be dispensed with without involving a considerable loss of effect, even when working with steam of only atmospheric pressure.

It is not a doubtful but a well-proved fact, that steam cannot be deprived of its temperature without a proportionate loss of its pressure; it is also a well-known fact, when steam of a certain temperature, say 250°, is brought into contact with iron, wood, or air, having a temperature of say 80° only, there is a constant action going on proportionate to the conducting powers of the low temperature material, by which the steam is deprived of a portion of its heat and pressure, and the loss thereby increases rapidly with the difference between the two temperatures.

As a homely illustration on this point, we may refer to the effect of different temperatures in the case of the human body and the atmosphere in which it may exist. In the human body, the average temperature is 90°, and we find that we cannot remain in a surrounding temperature of 32° without losing a considerable portion of our sensible heat.

The amount of the loss, by conduction and radiation, in the steam-engine, is dependent on many circumstances. It is enough at present to draw attention to the fact that there is a loss, and that a considerable one.

To the appreciation of the importance of preserving the heat in steam intact, was due, to a great extent, to Watt's success as an improver of the steam-engine, and, whenever such preservation is neglected, loss and partial failure are inevitable.

It is not assumed that any new ideas or facts are developed in the preceding remarks; they are only intended to direct attention to those true principles of economy in the development of steam power, without which that economy is impossible, and one reason for referring to what may be termed first principles is, that we may have to trace present defects to their neglect.

There must, of necessity, be a difference between the results of theoretical calculations and those of practical experiment, but it is not a necessity that the amount of that difference should average more in 1859 than in the days of Watt, after crediting him with the advantages of mechanical construction we now possess.

It is to be feared that these mechanical advantages are more than counterbalanced by neglect of the true principles of economy in the use of steam, and that we are utilising a smaller per-centage of the total power of steam than Watt himself.

In these introductory remarks we shall not refer to certain sources of loss in the *generation* of steam, or to those arising from the difficulty of utilising the heat in the condensed or exhausted steam; these will be referred to on a subsequent occasion.

We may fairly compare the duty of the steam-engine, as improved by Watt in 1769, with the average duty realised by steam-engines now in general use; and we will only notice *exceptive* cases when they prove that an increased duty is both possible and practicable.

There are three separate classes—the professional, manufacturing, and the purchasing—immediately interested in the construction of a steam-engine, each of which has its own particular influence.

The professional engineer is comparatively a late creation, and his influence is quite subservient to that of the manufacturer or the purchaser; his position and success in life are, to a great extent, dependent upon his opinions being somewhat in advance of the age, and if he unites a fair amount of scientific knowledge with sound practical experience, he will not encourage the perpetuation of unsound and defective engineering; his responsibility and power are at present very limited, and it would be unjust to blame him for departures from true principles, when such have been the result of circumstances over which he had no control.

The manufacturing engineer has to satisfy the claims of what are too often opposite and conflicting interests. On the one hand he is supposed to supply the market with the best description of steam-engines, and on the other he has to make money, and avoid what may be called needless expenditure in producing his goods; he is also influenced by the opinions and requirements of his customers.

Now it does not follow that in manufacture the *cheapest* is the *best*; on the contrary, it is too often the other way, for it is well known, to produce an article at a cheap rate, and make the sale of it profitable, repetition must be encouraged, and alteration avoided.

To take an instance: in manufacturing a steam-engine a certain outlay is required for patterns, and when it is purchased at the market price for engines of a certain class and size, in a general way, that price is not affected by the cost of the patterns; but it is of every consequence to the manufacturer, as a matter of profit or loss, whether that cost is debited to one engine or to twenty; it follows, therefore, that, in this instance, there is in the process of manufacturing steam-engines a great inducement to repetition, in opposition to the more important demand for improvements tending to economy and general efficiency. And we may add, there is little hope of an immediate change in a system that, unfortunately, opposes such a strong barrier to real improvements, for the reason that a manufacturer will not ruin himself to benefit his customer.

We must look to the increasing intelligence among the purchasers and users of steam power for the change required, the influence exercised in the production and quality of steam power by the third or purchasing class being greater than is generally supposed. The man who holds the purse-striugs is the man of influence, and the eugineering character of the manufacturer has been, and always will be, greatly changed and modified by that of the purchaser.

Such a state of depressed improvement is not to be submitted to without a murmur, nor is it at all evident that great changes for the better could not be made, if the manufacturing engineer was more constantly and pointedly to enlighten the dark understanding of his customers.

The best interests of the employer of steam power are, in truth, identical with the purchase and use of the best and most economical machinery; and we believe the manufacturing engineer will ever prefer to lead the van in efficiency and economy, if he is allowed a fair profit on his manufactures.

And now, having stated *some* of the drawbacks to extensive improvements in the production and use of steam power, we wish to call attention to the actual efficiency of the steam-engine of 1859.

We have previously referred to the three inventions specified by Watt in 1769, and we propose to inquire what actual duty *has been realised* in engines, constructed in accordance with the principles of that specification.

The first practical application of steam power was for the purpose of pumping, and in no class of engine have economical principles of construction received such attention as in that used for removing water from deep mines; and it may be observed incidentally, with reference to the expansive action of steam, it was peculiarly adapted to the conditions of pumping, where great variation of power was requisite.

In Cornwall the duty performed by pumping engines has been regularly tabulated for some years, and the amount of that duty has, in several instances, amounted to upwards of 90,000,000 lbs., raised 1 ft. high in an hour, with a consumption of a bushel of coals, or 94 lbs.; and if to the above duty is added the friction of the engine and pumps, an indicated or actual power has been, and can be, obtained by the consumption of *less* than 2 lbs. of Welsh coal per hour.

The average duty of a number of eugines working at different rates of expansion in Cornwall may be much less than the above; but whenever due atteution is paid to the maintenance of the heat of the steam in the cylinder, and full scope is allowed to expansive working, the above economy can always be realised.

In the case of condensing engines, for driving mills and manufactories, in which steam-jackets and expansion have been combined, an indicated or actual horse-power has been obtained, without difficulty, with a consumption *not exceeding* 2½ lbs. of coal per hour.

We therefore maintain that, by attending to the principles of Watt's specificatiou, an indicated or actual horse-power can always be obtained from a well-made steam-engine, on land or on sea, by a consumption of good steam coal, *not exceeding* 2½ lbs. per hour; and we are aware that this statement is more moderate than well-established facts require; indeed, there is every reason to believe we might fairly adopt a much higher standard of economy.

As a concluding remark on this part of the subject, in no instance on record has the best result or highest duty been realised without special arrangements for maintainiug intact the temperature of the working steam and extensive expansive action.

Our next iuquiry is:—What is the *average* duty realised at the present time on land and on sea for the consumption of a given amount of coal? In reply to this, the following may be fairly assumed as undisputed facts:—

1. That, with land condensing engines, the average consumption of good steam coal per hour, to obtain an indicated or actual horse-power, is *not less* than 4 lbs.

2. That, with marine engines of the best general construction, made by first-class firms, the consumption of good steam coal per hour, necessary to obtain an indicated or actual horse-power, is *not less* than 4½ lbs.

3. That, except in a few instances, no provision is made for *maintaining the temperature of steam* in the steam pipes and passages, and during its expansion in the cylinder, either in land or marine engines.

4. That the advantages derived from the expansive action of steam, when the temperature of the steam is *not* preserved, are often so slight as to throw discredit on a principle which, when properly applied, is invaluable in economising fuel.

The conclusious to be drawn from the above are far from satisfactory, and quite justify the tone of these iutroductory remarks.

The steam engineering of 1859 is in a most defective condition, and the results of such deficiency are incalculable.

In steam-ships alone we have at least one and a half millions of actual or indicated horse-power; and if we only suppose this power to be exerted during one month out of the twelve, we are needlessly throwing away fuel to the amount of 100,000 tons per annum.

Figures and calculations must fail to convey a correct estimate of the loss incurred by defective steam engineering; and in the case of steam-shipping, the actual amount of fuel saved is only a portion, and sometimes a small one, of the saving in freight, &c., resulting from coal space available for cargo.

The astonishment expressed at the economy resulting from the use of superheated steam indicates, only too truly, how far we have departed in practice from first priuciples.

The facts, that the advantages to be derived from superheated steam can be obtained at a comparatively small outlay, and that its application is easy to existing machinery, will go far to bring it into favour: but it is matter of serious doubt if an improvement that is based on the existence of a previous defect is the *best of the kind.*

The economy resulting from superheating steam must convince the most sceptical that in all engines—where the cylinders are merely clothed to prevent radiation—at least from 20 to 30 per cent. of steam is needlessly condensed during its passage from the boiler to the condenser, and it is the surplus heat supplied from the superheated steam that prevents this waste, and saves the fuel.

We are but *entering* the field of improvement in steam engineering, and the amount of duty realised from the combustion of a pound of coal is at present but a small per-centage of the total value of the heat given out by that coal.

Boilers, engines, condensers, must all be greatly improved; for each has its peculiar source of waste, the sum total of which is well known to be considerable.

We have thus, as it were, just glanced at the state of steam engineering in 1859, being conscious of omitting mention of many incidental causes for present defects. When we proceed to refer in detail to steam-engine construction, the opportunity will be afforded of embracing all points of interest.

WESTMINSTER BRIDGE.

We have pleasure in announcing to our Subscribers that we have in progress a series of plates, illustrating the construction of New Westminster Bridge, designed by Thomas Page, Esq., C.E., F.G.S., and which we hope shortly to present to them, together with such full particulars of its construction and arrangement as cannot fail to be extremely interesting and useful.

Before, however, we commence with them, we think a short sketch of the history and construction of the Old Bridge, which will, ere long, be numbered with the "things that were," will be interesting to our Subscribers.

We gather from the interesting description of Westminster Bridge, written and published in 1751, by Charles Labelye, that he was appointed engineer by the Commissioners to construct a *wooden* bridge at Westminster, which he designed and commenced; and on the 13th September, 1738, the first pile of the New Bridge was driven.

By the 26th of October, the piles necessary for building the two middle piers were all driven, and found to stand so firmly that all plates, wall pieces, ties, and braces, were considered superfluous, and were accordingly omitted.

The number of piles for the first large pier was thirty-four long, and twenty-two short ones; and for the other large pier, twenty-six long ones.

Labelye, as we read, plumed himself not a little in being able to dispense with coffer-dams, and the other expensive adjuncts, to such a plan of proceeding.

The original intention was, as we have seen, to construct a wooden bridge, which was commenced as above described, but a great frost interrupting the works, and carrying away some of the woodwork in the river, gave occasion to the public to express their disgust at a wooden bridge being erected in the metropolis of the British Empire. This led to an inquiry as to the cost of maintenance, which, with other considerations, caused the abandonment of the wooden bridge; and Labelye was accordingly desired to prepare a design suited to the number and sizes of the piers already resolved upon; and this he presented to the Commissioners on the 12th March, 1739-40,

This bridge was 1,220 ft. in leugth, and consisted of thirteen large semi-circular arches, two smaller arches, fourteen piers, and two abutments. The centre arch had a span of 76 ft. and the arches decreased towards the sides, as also the piers, 1 ft. in width. The arches spring from 2 ft. above the level of low-water mark. The whole breadth of the bridge is 44 ft. from out to out, with a carriage-way of 28 ft. in the middle.

Labelye remarks, that attempts to obtain such a bridge were made in the several reigns of Elizabeth, James I., Charles I., Charles II., and George I., and "constantly defeated by means too well-known to require my mentioning them."

About the beginning of October, the grating belonging to the first pier was finished, and the sides of the caisson on which the piers were built, and which were 16 ft. high, began to be raised upon it. When the pier was built so high above low-water mark as to render the use of the sides of the caisson unnecessary, they were removed, and the work proceeded without them.

These caissons were 80 ft. × 30 ft., and built of fir (which was chosen as being the cheapest, easiest worked, and as good as any other) with framed bottoms, resting on sole pieces, which projected 7 in. or 8 in. below the bottom of the caisson. Each caisson contained 150 loads of fir timber, and was of more tonnage or capacity than a man-of-war of 40 guns; when finished, they were floated to the place they were intended to occupy, and the pier being constructed in them up to a certain height, they were sunk to the bottom, where a bed 6 ft. in depth, of the same shape as the caisson, and 5 ft. wider all round, had been previously dredged out to an even flat surface, with a slope all round sufficiently gentle to hinder the ground from falling in again; and, in order to prevent the loose silt and washing of the river from coming into the pit, short grooved piles, reaching about 4 ft. above high-water mark were driven before the two ends, and part of the sides of the intended pier at about 15 ft. from the sides of the caisson, and two rows of boards were let into the grooves down to the bed of the river, and kept from rising by ledges of wood nailed in the grooves of the short piles.

On the 15th January, 1738-9, the caisson was launched, and on the 29th of the same month the masons began hoisting some stones into the caisson; and, in the afternoon, the first stone (the middle one in the foundation of the first pier) was laid by the Right Honourable the Earl of Pembroke.

In the beginning of February, near the time of low water, the caisson was sunk to see how it set and grounded, but as it was found that some loose ground had tumbled into the pit from a barge having been maliciously sunk over it, the caisson was made tight, and after two hours' pumping, floated as before.

On the 17th February, the necessary observations having been made to sink it in its right position, the caisson was suffered to sink for the last time, and it was found to bed on ground so true for its position, and so level, as not to need the least alteration.

By the 24th of March, having worked night and day, as the tides suited, the solid shaft of the pier was finished, and on the 30th the sides of the caisson were floated off, and immediately employed in the same manner for the other large pier.

On the 5th May, 1740, the fourth pier was begun, and was completed in the short space of twenty days. This, Labelye remarks, he considers to be a fact worth mentioning, as it shows what despatch could be made by this manner of building, whenever a sufficient quantity of Portland stone could be procured from the quarries.

On the 14th of August, 1740, the building of the arches was begun by setting the N.W. springers of the middle arch; and on the 21st February, 1743-4, the fourteenth and last pier was finished, so that the building of both the abutments and all the piers was completed in five years and twenty-three days, including all stoppage and other hindrances.

On the 20th July, 1746, the last arch was keyed in; and on the 25th October, 1746, the last stone of all the abutments, piers, and arches, was laid, but without any ceremony, by the Earl of Pembroke, who had laid the first stone seven years eight months and twenty-seven days before, and, excepting the foot pavements and balustrades, the bridge was then entirely finished and fit for service.

On the 25th July, 1747, the last centre was taken down, and all the fifteen arches of the bridge were left entirely free and open.

On the 14th November, 1747, the bridge, and the roads and streets on both sides were completely finished, the whole time occupied being seven years nine months and sixteen days, from the laying of the first stone.

Thus far all appears to have progressed favourably; but in the months of May and June, 1747, the western fifteen-foot pier had been observed to settle gently at first, but so much further towards the end of July, 1747, that it became needful to take off the balustrades, paving, and part of the ballast that laid on the pier, and the two arches adjoining, and the mischief became so serious as to render it needful to set up centres under the two damaged arches; but what with delays and other matters, it was seven months before they were set up. However, it became necessary to take down and rebuild the two damaged arches, and, by the 18th November, 1750, the new bridge, as it was then termed, was completed and opened to the public, having been just eleven years nine months and twenty-nine days in building, from the laying of the first stone, and the entire cost, as stated by Labelye, did not exceed £218,800. He remarks, at the conclusion of his work, that St. Paul's was upwards of thirty-five years in building—contains little more than half the quantity of material that is in Westminster Bridge, and cost £736,800. One may from that and the following facts gather whether it is dear or cheap, and was slowly or expeditiously erected.

St. Paul's was built on dry land, without any tide or other obstruction in laying its foundations, and where they could employ and set as many materials as could be procured.

Westminster Bridge contains near twice the material; its foundations are all laid in the water, several feet below the bed of the River Thames; when, till all the piers and abutments were brought up above high-water mark, the tides, twice in twenty-four hours, did necessarily much retard and stop the progress of the building.

Having thus given a short sketch of the construction of the Old Bridge, condensed from Labelye's work, a perusal of which, by the way, will prove interesting to our readers, especially as there is a great similarity in the circumstances under which the present work is being carried out, as will be seen during its perusal, we may remark, that the cause of the failure of the piers of this bridge, was the sinking of some parts of the bearing surface of the area on which the caisson rested, thus causing an unequal pressure, and increasing the evil until it became necessary to take down the arches, as mentioned by Labelye. That this is the solution of the problem is evident, inasmuch as although the pier and ground had been protected against the scour of the current by the sheet piling mentioned in his work, which were perfectly successful for that purpose, still the piers have sunk, and the bridge can now only be considered as very unsafe, and as a most unsightly nuisance.

We think that in all cases where practicable, a bridge should be so constructed as to prevent any liability of its foundations being injured by the scour of the current, and for this purpose it becomes desirable to obtain as large an area of water-way as possible, in order that no obstruction be presented to the free passage of the current, and thus any increase in its velocity be prevented. That this alone will add in no small degree to the lasting character of the present beautiful bridge now constructing, will be evident on a slight comparison with the present structure, where the superior area in the New Bridge, and the precautions taken in deepening the water-way will rather induce a *deposit* than a *scour*.

BOYDELL'S TRACTION ENGINE AND ENDLESS RAILWAY.

An engine and train of five four-wheeled waggons, constructed expressly for Venezuela, S.A., have been employed during the last fortnight in drawing coals from a colliery, at Little Hulton, near Worsley, belonging to Messrs. J. Gibson and Co., along the public roads, into Manchester, a distance of 8 miles.

The road is undulating, and has several sharp curves on it, but the engine and train were turned and managed with the greatest facility and ease by three men, viz.—one to steer, one to attend to the engine, and one to mind the waggons and break. The five waggons weigh above 2 tons each when empty, and contained 4 tons of coal each, making the gross weight drawn by the engine considerably more than 30 tons, exclusive of its own weight, which is about 11 tons. This load is regularly drawn with the greatest ease by the single power of the engine.

The above distance was regularly performed, including twelve minutes' stoppage to water, in a little over three hours and a quarter, but it could easily have been performed in less time had it not been for the crowds of carts and other vehicles, which rendered it necessary to follow behind them, at whatever rate they were moving, frequently for above a mile and a half, until an opportunity could be found to pass them.

On the road leading into the coal yard is a sharp turn, at right angles, with the steepest gradient on the road, which was on every occasion, whether with a load or without, easily and beautifully turned without stopping, each waggon following exactly in a line as though they were on a tramroad, a peculiarity which is confined to the waggons or carts constructed on this principle.

The engine has two horizontal cylinders, each 7 in. in diameter and 12 in. stroke, and the driving-wheels are 7 ft. in diameter, and have each the endless-railway fitted to them. In the front of the engine, on the steering platform, is the elevating screw, by means of which the boiler (and, consequently, the water in it) is always kept in a horizontal position, so as to prevent any risk of overheating either the tubes or the firebox when ascending or descending an incline.

By this arrangement the utility and safety of the engine are enormously increased, and it can go into almost any position where wheels can be employed, which, without its aid, it would be exceedingly dangerous to attempt. As far as we are aware, this screw arrangement is peculiar to this engine, and it cannot fail to be considered as a very great and important improvement.

On the crank shaft, at either end, are small wrought-iron pinions, gearing into the top of the large toothed wheels attached to the driving-wheels, and by means of which the engine is propelled. These pinions can be easily thrown out of gear by a lever and clutch, so that the engine can drive from either one or both wheels. On going round a curve, by throwing out of gear the *inner* pinion, and driving from the *outer* one, the engine can be made to make a very sharp turn, and by putting the opposite pinion into gear, and throwing out the other, it can be turned as sharply in the other direction. On an intermediate shaft are keyed a larger and a smaller pinion, one of which works on the larger toothed driving-wheel, and the other into the driving pinion, so that the power of the engine is doubled, but the speed is reduced in a corresponding degree. This power has only been used when ascending an incline of one in thirteen with a load of above 30 tons behind it, the single power having been found equal to any part of the road on which it has yet been with its load. The engine, when not in use for traction purposes, is used as a stationary engine, by putting both driving pinions out of gear, and putting a belt on the driving drum.

The boiler is an ordinary locomotive tubular boiler, and is supplied from a tank suspended underneath, the size of which may be adapted to the purposes required. The engine is fitted with the link-motion reversing gear; and the steam pressure varies from 70 lbs. to 100 lbs. on the inch, the average working pressure being about 85 lbs. The consumption of coal is about $\frac{3}{4}$ cwt. per mile; but this depends on the state of the road, that is, whether any delay is caused by the crowded state of the traffic, rendering it necessary to travel at a slower rate, and consequently be a longer time on the journey. The engine is easily steered by one man, who rides on the steering platform in front, manages the elevating screw, and steers by a horizontal wheel, which, by means of pinions and a quadrant, turns the fore axle, and causes the engine to turn and the train to follow after.

This engine is a great step in advance of the former engines, having several important improvements introduced into it, and being also far more sightly and efficient; and, from the gradual introduction into each succeeding engine of everything that will make them more complete, there can be no doubt that ere long they will take a very prominent position, and, in fact, become indispensable for moving heavy loads under all or any circumstances. The wear on this engine up to the present time is inappreciable, and stands in a very favourable position when contrasted with the work done, even were it tenfold.

The engine and train have been inspected by thousands of persons, amongst whom have been most of the leading scientific and practical men in Manchester, and are causing a profound sensation amongst mine and coal owners, contractors, and others interested in the economical removal of heavy loads in large quantities, the expense by this system being less than one-third the cost by horse labour, and it has satisfied every one, that it is the only engine yet known, that can make its way over every description of ground, however soft, sandy, hard, or uneven, without injury to the road, or to itself.

It has been taken with its entire train (a total length of more than 100 ft.) through the crowded streets of Manchester in all directions, with the greatest ease, and without the slightest accident, turning all descriptions of corners. It appeared to satisfy all practical men, that road locomotion, without injury to the roads, and ease and facility of management of the engine and waggons in the crowded streets, on curves, and inclines, are now most perfectly and efficiently attained in the system of the endless railway.

We congratulate the company on the success which has attended this, their first introduction of this important system into Manchester, there being no place where its capabilities can be more fully appreciated, or where it can be adopted with greater advantage. We understand that an ample proof of this has already been given, in the numerous orders they have received for engines and trains of waggons.

THE MANUFACTURE OF LEAD SHOT.

(Illustrated by Plate No. 146.)

(Continued from p. 85.)

Sheet No. 6 shows detailed views of one of the sorting cylinders. Fig. 1 a side view; Fig. 2 the driving end; Fig. 3 a transverse section of the same; and Fig. 4, a plan. s, is the upright shaft, imparting motion from the engine to the horizontal shaft, *j*, for driving the screws. T T, standards of the screw machines. U, pinion on the shaft, *j*, sliding on a feather, so that it may be disconnected from the machine. V, bevel wheel on axle of screw cylinder. W, the screw cylinder. X, small hand-carts for receiving the shot from the machine. Y, waste boxes for receiving any imperfect shot; and Z, the boards for separating the imperfect from the good. The left-hand end of Fig. 4 represents the body of the screw cylinder, with the threads put in, whilst the right-hand shows it in a finished state, with the copper perforated plates put on.

A part of one of these plates is represented by Fig. 5, at full size. The cylinder is enclosed in a wooden trough, as seen at Figs. 3 and 4, where *a* is the bottom, *b* a whole and fixed side. There is a longitudinal brush at *c*, in short lengths, for clearing the holes in the copper plates, and which are kept up with the required pressure by set screws. At the top edge of this side is hung the cover of the machine (see dotted lines), divided in two or more pieces, as may be preferred. The side, *d*, is fixed as high as *d x*, to which the upper part is hinged so as to fall down, that the cylinder may be examined (see dotted lines here also).

The delivery boards, Z, are furnished with slips at each side forming a groove or slot, so that the shot may fall vertically, as shown at *x x*. Fig. 6 represents an end view of the chain barrel, tooth wheels, &c., for hoisting to the top of the tower. Fig. 7 a plan of the same, and Fig. 8 a side view. A, the barrel, with leading grooves; B, a spur wheel, fixed to barrel and shafts; C, pinion; D, spur wheel; E, friction brake wheel for lowering, fixed on the second shaft; F, shaft from engine; G, pinion, sliding on a feather for throwing out of gear.

THE FRENCH GUNBOATS.

Some erroneous statements having appeared in several periodicals in reference to the gunboats now constructing in the South of France, it may interest our readers to have a correct notice on the subject.

These boats are about 80 ft. long, 16 ft. wide, and 7 ft. deep; the draft of water is 4 ft. 9 in., with a displacement of 85 tons.

The only peculiarity of these boats is, that the gunners are protected by an oak screen about 1 ft. thick, plated with wrought iron $4\frac{1}{2}$ in. thick. This screen is perpendicular to the deck, and is a flat surface; it is about 6 ft. 6 in. high, of the entire width of the boat, and in the middle a port is left open for the single gun on board, which is a long 36-pounder.

It should be observed that the oaken part of the screen above alluded to descends to the bottom of the boat, forming below the deck a strong watertight bulkhead, destined to stop the shots which might pass through the bows of the boat.

Each boat is fitted with a single high-pressure engine of about 20 nominal H.P., driving by direct action a screw at the rate of 200 to 220 revolutions per minute. Several of these boats are already launched and on trial; the speed attained was $8\frac{1}{2}$ knots, with the steam in boiler at a pressure of $4\frac{1}{2}$ atmospheres.

It has been stated that these boats are building at La Ciotat, near Marseilles; but this is a mistake. There is a fine dockyard at La Ciotat, employing nearly 2,000 men, belonging to the Company of the Messageries Impériales, but these works are wholly devoted to the wants of the fine fleet of steamers belonging to this Company. The gunboats are building at La Seyne (on the Bay of Toulon), at a shipbuilding yard of the "Companie des Forges et Chantiers de la Méditerranée," while their engines and boilers are being executed at the engineering works of the same Company at Marseilles. It may be interesting to remark, that these establishments, which employ about 3,000 workmen, were created rather more than twenty years ago, by Mr. Philip Taylor, an engineer well known to scientific men. This Company is now under the able management of a body of directors of high standing in France.

COAL IN THE URAL.

Notwithstanding Sir Roderick Murchison's reiterated opinion, that coal could not, geologically, exist in any part of Siberia, and that the Ural chain of mountains, rich in gold, copper, and other valuable metals, was entirely destitute of the most important material for rendering some of these metals useful to Russia—*coal*, we are enabled to state, on the authority of an English engineer, Mr. Robert Wardropper, formerly of Newcastle, but for several years past resident in Russia, that coal does not only exist in those parts of the Russian Empire, but also that in the Kergese Steppes he has discovered, and been able in one place to trace distinctly for several miles, no less than *sixteen seams of coal*, varying in thickness from 2 ft. to 28 ft. A seam of 28 ft. thick, running along the bottom of the ridge, cropping out at the surface, is now being *quarried out.*

These seams of coal appear to be of excellent quality, judging by the specimens we have seen; and as the sixteen seams of coal at present discovered cropping out exist within a horizontal distance of *two miles*, and extend a distance of many miles in length, it cannot be doubted that this is one of the most important discoveries for the development of the great mineral resources of this part of the vast Russian Empire, which has ever been made.

The 28 ft. seam dips 3 in. in 1 foot, and the combined and alternating series of coal and shale, of about 20 ft. in thickness altogether, dips about 2 in. in a foot; the highest seam, which has yet been discovered, of the series, 22 ft. thick, lies at about the same angle.

Altogether this is one of the most interesting discoveries which has been made for many years.

NOTES OF EVENTS, INTERESTING TO THE ENGINEERING PROFESSION, IN THE UNITED STATES.

By a U.S. Engineer.

The Philadelphia Press, Jan. 31, states, that the steamer *North Carolina*, bound from Baltimore to Norfolk, caught fire on Friday night, 28th ult., and was burned to the water's edge. Two persous lost their lives.

The Philadelphia Ledger, Feb. 3, states, that the boiler of the steam-mill of W. B. Horton, located about 10 miles north of Florence, Georgia, exploded on the 18th ult., blowing the entire mill to pieces, and killing three persons. The boiler was thrown about 100 yards up a hill, demolishing every thing in its course.

From Philadelphia Press, Feb. 22.—At Plymouth, Michigan, on the 17th inst., a boiler exploded in the mill of May and Co. Two men were instautly killed, and several seriously injured. A piece of the boiler was forced through the wall of a neighbouring house, and passed between two ladies who sat nearly together, engaged in sewing, and killed a little dog. The adjoining dwelling-house was nearly demolished.

From Philadelphia Ledger, March 1.—The boiler of the steam-pump on the steamer *Black Warrior* (run ashore near New York) exploded on the 27th February, destroying the smoke-stack and upper deck of the steamer, and tearing off one of the legs of the engineer.

From Philadelphia Press, March 1.—The steamer *Princess*, bound from Vicksburg to New Orleans, exploded her boilers, and was burned to the water's edge, at Conrad's Point, on the Mississippi, on the 27th February. 400 persons were aboard, of whom 200 are said to be missing.

From Philadelphia Press, March 5.—The locomotive engine, *Atwata*, exploded at Mingo Station, on the Stenbenville and Indiana Railroad, on the 1st March, instantly killing the engineer, fireman, and brakesman.

From Philadelphia Press, March 21.—The locomotive engine, *Meteor*, exploded on the 19th at Elkton, on the Philadelphia, Wilmington, and Baltimore Railway, killing the engineer and fireman, and damaging four or five freight cars.

From Philadelphia Press, March 21.—An express train on the Great Western Railway (Canada) fell into a chasm caused by the track being washed away by the recent storm near Hamilton, on the 19th inst. The cars were completely wrecked, and the engine was buried in the soil. Six persons were killed, and nine badly wounded.

From Philadelphia Press, March 28.—The propeller steamer, *Lady of the Lake*, exploded on Lake Michigan on the 26th; two person were killed, and the vessel with a cargo of flour and provisions was sunk.

From Philadelphia Press, March 31.—The locomotive engine, *Perkiomen*, exploded on the Philadelphia and Reading Railway, at the Schulkyll Bridge, about 5 miles from Philadelphia, yesterday morning. The engineer and fireman were killed, and the engine was completely destroyed, the safety-valve and pump being thrown completely across the Schulkyll.

The *Winans* cigar steamer, or as our Capt. West calls it, the steam-porpoise, is uoticed in The Artizan, and the probability of its crossing the Atlantic Ocean in six days questioned; and I think it would have been perfectly safe to have questioned its ever crossing the Atlantic at all. I will venture to say that, it has already performed the bulk of its usefulness, which is that of having kept a number of hands employed during the winter season in its construction. Every appearance of it is calculated to induce one to think that the builder of it had better confined himself to locomotives, or other contrivances for aërial navigation, for it is, certainly, a very good form for a steam-balloon—in fact, is very much like one that is now in course of construction at Boston; the latter being made, however, of thin sheet-copper; and of which, perhaps, we shall hear more anon—but what are we not destined to do by steam! Not content with having it perform all kinds of labour, warming our dwellings, offices, extensive steam-boat saloons, baking our bread, and doing divers other cooking, we now have it to perform the most splendid music to delight our ears.

Steam Music.—"A large number of persons visited Market Street Wharf, yesterday, to hear music produced by steam, from a "Calliope," which was placed on the upper deck of the steam ferry-boat *Mary*. The Calliope on exhibition is merely a combination of steam whistles, which are operated upon by a revolving cylinder, similar to a hand-organ. The music produced is much better than most persons imagine could be rendered by such an instrument, having a softness and correctness of tone truly astonishing. Those who assembled on the Wharf were treated with "Pop Goes the Weasel," "Rory O'Moore," and other tunes, in a style but seldom heard, and with a power equal to a hundred instruments filled with human performers. The manufacturers recommend these instruments to the owners of steamboats, so that on the approach of each boat a different tune can be played, thus signalizing to those in waiting the name of the boat. These instruments can also be attached to locomotives, so that the engineer can play "Get Out of the Way" on leaving the depôt or when approaching a crossing, and the "Campbells are Coming," when nearing their destination. The introduction of these instruments on board of steamboats, will obviate the necessity of hunting for cracked trombones, ponderous drums, French horns,and other accompaniment of a band for excursion parties. There will then be no danger of provoking *contre-temps* in the merry dance, in consequence of the "cornet" having smelt at the lager, or the "big fiddle" becoming unsteady from over-exertion in his arduous duties; for while the fire is kept beneath the boiler, and some can be found to turn the crauk, the music and the dance can go on."

The use of steam fire engines is rapidly displacing the old method of machinery for extinguishing fires; these new machines are comparatively light, of elegant construction and proportions, and drawn with nimble speed to the scene of action by two horses (steam power being generated on the way), with the exception of some which are self-propelling; but the latter do not, I believe, serve so good a purpose. The following is an account of a trial of a couple of those drawn by horses, just completed.

Trial of the "Good-Will" Steam Fire Engine.—Yesterday, at noon, a trial of this new apparatus took place at the establishment of I. P. Morris and Co., the builders, Nineteenth Ward. The engine was stationed near the dock, and drew her supply of water from the Delaware. Steam was raised in twelve minutes, and in twenty minutes from the time of lighting the fire she commenced to play. With 80 lbs. of steam a stream was thrown 213 ft. through a 1 in. nozzle, and with a nozzle 1⅛ in., 193 ft., measuriug from the end of the nozzle. These distances were the extreme points which the smallest particle of water reached, but the main body fell 20 ft. or 25 ft. short. The playing was with the wind, which caused the streams to spray somewhat. The engine worked with much ease and steadiness. The pipe streams were easily managed by one man, and at one time a small boy held the pipe and directed the stream without difficulty. The trial was witnessed by a number of the members of other steam fire engine companies, the officers and building committee of the "Good-Will," and was superintended by Mr. Alexander McCausland, the designer of the apparatus. It is the first that has been built from Mr. McC.'s drawings.

The Weccacoe Steam-Engine.—The members of the Weccacoe Steam-Engine Company gave their new steamer a trial, March 21, in front of their hall, Second Street, below Queen, which proved every way satisfactory, playing a solid stream, through a 1½ in. nozzle, 180 ft., and threw a 1¼ in. over the Southwark Hall, and a 1⅛ in. over Sons of Temperance Hall at the same time. A more solid body of water we never saw thrown to so great a distance before. The steamer was built in a superior manner by Merrick and Sons, the iron-work furnished by Samuel Lenon, and the wood-work by J. J. Dallas. The Weccacoe is now one of the most useful companies in the city, being prepared with hook and ladder, and every apparatus in case of emergency. It is one of the oldest companies in the city, and in that section of neighbourhood calculated to be of great benefit in case of fire.

In regard to the general use of steam, however, there is yet one exception. Although the city passenger railways are reduced to great proportion, and the passenger traffic extensive and very profitable to stockholders, so far it has been considered best to draw the carriages by horses; and everything relative to running, stopping, starting, &c., works so proper and convenient, that I doubt the possibility of the use of steam in this case being made an improvement.

I have been examining an eugraving and description of a steamboat called the *Indus Steam Flotilla*, built by Mr. J. Scott Russell, for navigating the Indian rivers. It is stated that of all the designs sent in by competitors, that Mr. Russell's was preferred. I have so much respect for Mr. Russell's engineering skill, that I do not doubt his plan being the best, but I cannot refrain from wondering what a burlesque on steam-boat building those designs that were offered must have been.

Like all English steam-vessel building, no matter for what kind of navigation intended—except that in this instance the bottom is flattened—it is in almost every particular a steam-ship. Encumbered with three eugines, driving a pair of wheels of too small radius for shallow water—deck arrangements carrying neither cargo or passengers conveniently—stripped of all that deck room that can be made so useful in a river steam-boat, by tapering the wheel-guards each way to stem and stern, and on which it frequently serves a good purpose in the navigation of shallow waters to plan the boilers. The steering apparatus is too far back from the bow for the helmsman to discover the little dangers that are contingent to a river boat, whilst he is also exposed to winds and storms, for want of a cab or wheel-house to protect him.

If boats are to be constructed in England where engineers can have no experience in the peculiarities of shallow river navigation, why not send a commission to the valley of the Mississippi, where there are 25,000 miles of rivers on which alone float 40,000 tons more steam craft than belongs to the kingdom of Great Britain. There they will see boats in which every stick of timber and bar of iron is shaped to the best advantage, boats of every draft of water to suit the river they expect to navigate, with the hull arranged to carry the greatest amount of cargo; above and out of the way of which extends nearly from end to end the passenger deck, on which is a saloon, its whole length opening right and left to convenient state rooms, the latter having doors opening outwards to a balcony or promenade. These boats are generally driven by two engines, the shafts of which are connected by a common clutch, and can be disconnected at any moment, by a lever, that it becomes necessary to turn the wheels at a different speed, or perhaps reverse one, in case of turning short reaches. This arrangement is of the greatest importance, as a heavy boat will not mind the rudder sufficiently quick in a narrow shallow channel when the current is rapid, for even with the best of management in such cases it is impossible sometimes to avoid running aground. The contingencies of these western boats vary very much, of course, from those running on bolder waters, such as the Hudson, Potomac, or the Delaware, where a single engine of long stroke always proves less for speed and economy of space, &c.; in fact, many of them are capable of running 20 miles, and some have even made 25 miles an hour; but I say again, in constructing river boats for the East Indies, why not, instead of beginning anew and going over the old ground, rather improve upon the fifty years' experience of a country, the very nature of which, of all others on the globe, has developed the greatest reasons for calling forth the inventive faculties of man to supply the wants in that line, for surely the *Indus* steam flotilla for the uses intended is no great improvement on Captain Smith's boat, built on the Ohio River in 1811, and in which he introduced the two cranks as now used in steam-ships and locomotives.

In the construction of these flat boats, the combination of the bridge and boat principle is of the greatest importance; and, should the Indus Steam Flotilla, with a varied load stretched from end to end, get lodged upon its centre on the rough bottom of some rapids, or mounted upon the pinnacle of some rock, like the "Gridiron of Hell-gate," I fear, for the want of that arrangement, which is not sufficiently supplied by the guides described, that she would break her back.

The following relates to Silver's Marine Governor, from the "Press," of March 22nd, viz:—The Secretary of the Navy has ordered the Engineer-in-Chief to require the contractors for the sloop of war *Lancaster* to place on it "Silver's Marine Governor."

ON IMPROVEMENTS IN PUMP VALVES.

By Mr. John Hosking, of Gateshead.

(Illustrated by Plate No. 143.)

In the various arrangements and constructions of pumps for raising water and other fluids, the perfection of the pump depends mainly upon the valves, whether applied as fixed clacks or in the buckets; and their improvement has consequently attracted much attention for some years past, especially in connection with waterworks for the supply of towns.

The writer's attention was more particularly directed to this subject about the year 1843, whilst engaged with Mr. Wicksteed at the East London Waterworks, shortly after the introduction of the double-beat valve. This valve, of which a vertical section is shown in Fig. 1, Plate 143, was found to be, for large pumps, a most important improvement on the leather flap valves previously in use. The double-beat valve, however, was not free from objections, as it burdened the engine by requiring a pressure of 2 to 5 lbs. per square inch to lift the valve, and was also liable to get cross bound on the guides after becoming worn, and then to fall suddenly, producing a great shock on the engine, and fracturing the valve. In its construction also there is the objection of the tortuous passage through which the water has to be forced; and further, however large the size, it has been found necessary to limit the lift to 3 or 4 in., and consequently to check the opening or waterway, otherwise the fall or closing of the valve produced a concussion that was very detrimental to the valve itself, as well as to the engine, pumps, and building. On the first introduction of the Cornish pumping engine for waterworks on a large scale, it is questionable whether, with the valves then in common use, it could have been worked to advantage, had not the double-beat valve been devised to meet the difficulty which attended the percussive and rapid motion of the in-door or pumping stroke.

The evident requirements for pump valves are a large area of waterway, with a small amount of rise of the clacks, so as to diminish as far as possible the cause of concussion; and durability, which is secured by ease in opening and shutting with the smallest amount of beating action.

A variety of constructions of valves have been designed within the last few years, in which these objects were aimed at. Amongst the number may be instanced Mr. R. Hosking's annular valve, shown in Fig. 2, Plate 143, and Mr. R. Jenkyn's valve, shown in Fig. 3, Plate 143; both of these consist of a series of separate rings, each one falling upon the ring below, so that the top ring has to rise as much as the rise of all the others added together, in addition to its own rise. About the same time, an ingenious valve was constructed by Mr. J. Simpson, shown in Fig. 4, in which a series of separate rings are also employed, each having two beats, and falling upon a fixed seat, so that the lift of each is independent of the others. In this valve, the writer understands that the difficulties were similar to those experienced in the double-beat valve previously referred to, and that it was even more readily subject to derangement from small chips of wood or other obstructing substances that might accidentally get into it.

In consequence of the experience of the difficulties and objections attending the different forms of valves at that time employed, the writer was led to the consideration of some other principle for the basis of construction; and in the course of inquiry the idea of the gills of fishes suggested itself, which open simultaneously a series of passages, giving free exit to the water, and closing again completely with great ease of motion. The first form of valve designed on this principle, and termed from that circumstance a "gill valve," is shown in Figs. 5 and 6, Plate 143, and consists of a series of annular seatings, each furnished with a leather ring divided into a number of small clacks. Fig. 5 is a vertical section of the valve, and Fig. 6 a plan, part showing the arrangement of the clacks in each ring, and part with the clacks removed, showing the seatings. Fig. 7 is an enlarged section of one of the leather clacks. The metallic seatings for the leather rings are arranged in a pyramidal form, so as to afford a free entrance and exit for the water at each ring without interference from the adjoining rings; and by this arrangement the valve is capable of being constructed so as to have an area of discharge exceeding the area of the supply pipe, with as small amount of motion or lift of the clacks as may be desired. Each ring of leather forming the clacks is hinged along its inner circumference by being simply nipped by the projecting edge of the seating above, as shown enlarged in Fig. 7, the whole being tightened and secured by the centre bolt. It should be remarked that this valve does not require any more room in the box or chamber than the ordinary valves, which is an important point in pit work for mining purposes. Figs. 5 and 6 show one of the gill valves lately made for the Kent Waterworks, in which the area of discharge exceeds that of the suction pipe by 30 sq. in., or about 10 per cent.

These valves can be constructed either with separate leather clacks as above described, or with continuous rings of leather or india-rubber. With india-rubber rings the author has been more successful than he at first anticipated, as he doubted their durability and proper adaptation where high pressure was required; late experience has, however, shown that this doubt was unfounded. Figs. 8 and 9, Plate 143, show one of these valves constructed with india-rubber rings; Fig. 8 is a vertical section, and Fig. 9 a plan, part showing the successive rings in position, and part showing a plan of the lowest seating with the india-rubber ring removed; Fig. 10 is an enlarged section of one of the rings and the seating on which it rests. When india-rubber rings are used, the width of the spaces between the bars of the seatings is reduced and the bars made narrower, as shown in the plan, Fig. 9, the width of the spaces being made equal to the thickness of the india-rubber, which is proportioned to the height of the lift, and varies from 37 in. to 1 in. and upwards in thickness. It will be seen that in valves of this construction the size in no way regulates the lift or rise of the clacks or rings, and that the diameter is unlimited. About twelve months since one of these valves with india-rubber rings was supplied to the East London Waterworks, of 4 ft. 3 in. diameter, as shown in Figs. 8 and 9: this valve is now working admirably, having been in constant use since supplied, and from a late examination was found to continue as sound as when new, and absolutely tight, delivering 150 cubic ft. at each stroke under a pressure of 125 ft. head, working at the rate of 7 strokes per minute; the steam engine has a 100 in. cylinder.

Another modification of the same principle of valve is shown in Figs. 11 and 12, Plate 143, in which the rings are replaced by a set of india-rubber balls, arranged in circles in the form of a pyramid as before, each ball falling into a separate conical seating, as shown in the plan, Fig. 12, and the enlarged section, Fig. 13. One of these valves was supplied to the Hull Waterworks about four years ago, and has been working in an occasional assistant pump during that time under a pressure of 160 ft. head: one of the balls from this valve has been forwarded for the inspection of the meeting; and the author is informed that the weight taken out of the balance-box of the engine, when this valve was put in place of the previous double-beat valve, amounted to 5 cwt. or about 8 per cent. reduction of the whole load upon the engine. It should be observed that a difficulty has been experienced in the application of these ball valves, when used as suction valves in pumps worked by the Cornish engine, on account of the rapidity of the in-door stroke and the valve not closing quite quick enough; this has led some engineers to prefer in such cases the leather valves previously described, in which the clacks are easily loaded according to their requirements. When the motion of the engine is uniform or regulated by a flywheel, it is the opinion of all who have used the ball valves that they are equally applicable both as suction and delivery valves.

These valves have been in use somewhat extensively as air-pump buckets for steam-engines, as shown in Figs. 14 and 15, Plate 143, for upwards of two years; and the author is not acquainted with any case where they have failed. This, however, is not more important than their entire freedom from that objectionable jolt or blow, which in some instances in marine engines not only shakes the whole vessel but even causes a limit to the speed at which the engines can be worked.

Figs. 16 to 19, Plate 143, show the arrangement of the same valves for the buckets of pumping engines. Figs. 16 and 17 are a vertical section and plan of a bucket fitted with rings of small leather clacks. Figs. 18 and 19 show a bucket furnished with india-rubber rings, constructed for a lift of 300 ft. Figs. 20 and 21 represent one of the common buckets at present in use, showing the large size of the clacks and the great amount of fall as compared with the valves shown in Figs. 16 and 18.

In these valves it will be seen from the drawings that each successive seating is made to act as a guard to the ring, clacks, or balls next below it, regulating the extent of lift; and the simplicity of construction, each seating fitting into the one below by a turned joint without bolts and nuts, the whole being secured by the central fastenings, renders these valves compact and free from liability to get out of order, whilst the great freedom of water passage and consequently small amount of motion required in the clacks or rings insures their durability.

DESCRIPTION OF THE LOCOMOTIVE ENGINE SHED AND TURNTABLES AT THE GATESHEAD STATION.

By Mr. Edward Fletcher, of Gateshead.

(Illustrated by Plate No. 144.)

In the arrangement of large engine sheds, the important points requiring consideration are capacity and economy of construction, combined with facility of ingress and egress for the engines at all parts of the shed. In the shed forming the subject of the present paper, which is erected at the principal locomotive works of the North Eastern Railway at Newcastle-on-Tyne, an unusual number of engines had to be accommodated in one place; so many, that five separate buildings of the ordinary polygon arrangement would have been required, entailing a very heavy cost of construction.

From the convenience of the polygon arrangement for access to all the engines, the same general plan was adhered to as regards the engine-pits and turntables, which are arranged, as shown in the general plan, Fig. 1, Plate 144, in the same manner as if five ordinary polygon sheds had been constructed close together, in two rows alternating with each other, so that the lines joining the large turntables, A A, in the centre of each polygon, form three equilateral triangles. By this arrangement of plan, a direct line of rails is obtained, communicating from every turntable to each of the adjoining ones; and several distinct roads are obtained for entrance or exit at each of the turntables, one of them having five separate roads, while two of them have four, and the remaining two have three roads each. Then, instead of having the expense of building that would have been involved by the construction of five separate polygonal sheds, requiring a long range of wall, and an expensive construction of roof on account of the large span and polygonal form, the whole area has been enclosed by a plain rectangular wall, as shown by the diagram plan, Fig. 5, Plate 144, and covered in by five ordinary parallel roofs of moderate span, supported by four rows of columns running the entire length of the building, and falling in the intermediate spaces between the pits, without interfering with any of the lines of rails, as will be seen by the general plan, Fig. 1.

The result obtained is a covered area of 126,000 sq. ft. instead of 88,257 sq. ft., which would have been the area of the five polygons, or an increase of 43 per cent. in area, with a reduction of 37 per cent. in the length of walling, which is 1,476 ft. in the rectangular building instead of 2,340 ft.; the cost of construction being reduced in a considerably greater proportion, from the simpler and cheaper description of work in the rectangular building as compared with the polygons.

The additional space obtained in the rectangular building, as shown by the shaded portion in the diagram, Fig. 5, is found of great utility and convenience for carrying on the minor repairs done in an engine shed, such as changing wheels, &c., which is here accomplished without occupying any of the lines used by the running engines. For this purpose strong lifting frames are fixed over the spare lines in those parts of the shed, as shown at BB in Fig. 1, fitted with gearing for lifting the engines. Fitters' benches are also erected in the open spaces of the shed, as shown at CC. At DD are fireplaces for warming the shed and lighting the engine fires.

Fig. 2, Plate 144, is a transverse section of the building, showing the five separate roofs, of which the three centre roofs are 65 ft. span, and the side roofs 42 ft. 6 in., making the total width of the building 280 ft. The total length of the building, as shown in the drawings, is 450 ft.; but only two-thirds of this, or 300 ft., is at present built; the portion EE in the plan, Fig. 1, including two of the turntables, not being yet constructed.

Fig. 3, Plate 144, shows an enlarged transverse section of one of the 65 feet roofs. The principals are fixed at 12 ft. 6 in. apart, and the purlins are trussed with wrought-iron flitches, 4 in. by ¼ in. with 4½ by 4 in. wood. The principal rafters are constructed of two bars of channelled iron 4½ in. deep by 1½ in. wide on the flanges, with a 2¼ in. space between them, into which the T iron struts are fixed. The cast-iron columns, supporting the roof, are fixed at 25 ft. apart, and connected by cast-iron girders; and at F in the plan, Fig. 1, one of the columns is omitted for the convenience of the oblique lines of rails, and a wrought-iron girder of 50 ft. span is introduced, which is shown in Fig. 4, Plate 144.

A plan of one of the engine turntables is shown in Fig. 6, Plate 144, and a longitudinal section in Fig. 7, with a transverse section at the centre in Fig. 8, and a section at the end in Fig. 9. The table is 42 ft. diameter, and consists of two main wrought-iron girders, GG, 3 ft. deep at the centre and 2 ft. deep at the ends. These girders are secured together by a cast-iron cross H, which fits upon the fixed centre-pin I, by a cylindrical socket extending the whole depth and turning freely upon the pin. The centre-pin is of wrought iron, 9 in. diameter, and is fixed into a socket 2 ft. deep in the pedestal K, bolted down to the foundations; the pedestal is shrunk upon the pin, which is then secured by a key. The bearing for the table is taken at the top of the fixed centre-pin I, by a short steel pin L, 6 in. diameter, which revolves in a socket, 5 in. deep, in the top of the fixed centre-pin I. The bottom of the pin L is rounded at the edge, and turns upon a steel plate, 1½ in. thick, at the bottom of the socket. The pin has a flange at the top carrying a cast-iron cap, from which the whole table is suspended by six bolts taking hold of the cast-iron cross H, the bolts giving the means of adjusting the level of the table.

The outer ends of the girders are fitted with sliding wrought-iron wedges, which are moved by the handles M, and when pushed out rest solid upon cast-iron chairs, fixed upon the outer foundation curb at the end of each line of rails, and support the ends of the girders whenever an engine is being moved on to or off the table. A pair of safety rollers, N, is added at each end, running upon a circular rail O, but not in actual contact with the rail in the ordinary working of the table, being applied only as a precaution to prevent strain from the weight not being balanced on the table, or in case of accident to the centre-pin.

An engine and tender is readily turned upon the table by two men pushing at the end, without requiring gearing; the weight is so nearly balanced upon the centre-pin that the rollers at the ends do not take any appreciable weight in regular working; and the due placing of the engine on the table for this plan is sufficiently insured in practice by the circumstance that any neglect in this respect would increase the resistance to be overcome in turning the table.

An important advantage in this construction of turntable is the great facility for examining and keeping in order the only part that is subject to wear, namely, the steel centre-pin; this is readily done by fixing the sliding wedges at the ends of the girders, when the table becomes a rigid portion of the line of rails, and the steel centre-pin is taken out by simply unscrewing the six nuts, and the socket is readily examined, being close to the top of the table. These turntables have now been two years in constant use, and have given entire satisfaction, no attention having been required beyond ordinary oiling, and only one of the steel centre-pins having required to be taken out for examination during the whole time.

THE SCREW FLEETS OF ENGLAND AND FRANCE.

At a recent meeting of the United Service Institution, an interesting lecture on "The Screw Fleets of England and France in 1858-59" was delivered by Charles L. Pickering, Esq. The subject was illustrated by a number of admirable diagrams, prepared by the lecturer from the original models, and reduced to a quarter-inch scale; and, from the peculiar opportunities he has enjoyed of obtaining authentic information upon this subject, which at present absorbs so large a share of the public attention, there was a numerous attendance of distinguished officers of both services, Captain Fishbourne, R.N., taking the chair.

The lecturer first addressed himself to the argument that Sir William Symonds' ships, though not perfect, were the forerunners of our present best models of each class, and gave numerous proofs that the screw engines of our fleet in beauty of construction, power, and general efficiency, were unapproachable by the very best built abroad; and that our ships, when completed entirely upon the plan of Sir Baldwin Walker, were as near perfection as possible. These facts were proved by trials, at which he had himself assisted. He demonstrated that, from the small number of our ships, our admirals were unable to carry out Sir Howard Douglas's suggestions on the new combinations of tactics likely to come into practice, and which he foretold would be carried out in the French service. The lecture appeared to be designed as an answer to some anonymous letters that had appeared in the public journals, the authorship of which was acknowledged by a distinguished officer in the room; but also particularly to some ill-informed foreign writers, whose lucubrations had obtained immense circulation in some of the journals, and contributed proportionately to mislead public opinion here as well as on the Continent. In adducing numerous instances not hitherto made public in England, the lecturer expressed his opinion that, whilst naval architecture was on an equality, or nearly so, in both countries, our own was certainly not in a satisfactory state in respect of number, as compared with that of France, and verified the statements of Sir John Pakington and Lord Hardwicke on this subject; but that, in every other respect, we had no reason to fear a comparison with our gallant neighbours.

STEAM HAMMERS.

The following paragraph has recently appeared in several of the public prints:—"Messrs. R. Morrison and Co., of Newcastle, have just completed, for the Mersey Steel and Forge Company, the largest steam hammer in England, and probably in the world. The total height is 21 ft., and the width between the frames 14 ft. 6 in. The clear height from the ground to the under side of the frames is 9 ft. 4 in. The hammer bar is 15 in. in diameter, and 19 ft. long, and is made of steel, with the piston, which is 36 in. diameter, forged in one solid piece. The hammer bar forms a solid mass of steel, weighing above 7 tons in the finished state, with a stroke or clear fall of 6 ft. The gearing for working it is very simple. It consists of a single lever, which, in the hands of any competent engineman, is amply sufficient to render the huge mass obedient to the slightest wish of the forgeman. The cylinder is 36 in. diameter, and weighs, finished, above 8 tons; the two frames weigh 15 tons." In March, 1853, Mr. Condie erected a 6 ton hammer, with a 6 ft. stroke, at the Lancefield Forge, Glasgow, with a width of opening in the framing of 20 ft., or 5½ ft. wider than Mr. Morrison's hammer; this is the hammer with which all the large forgings of the *Great Eastern* were made. In July, 1857, Mr. Condie also erected, at the Glasgow Forge of Mr. Alexander Fulton, the 6½ ton hammer, with 7½ ft. stroke; this hammer has since been altered to 7 tons, with a width of 20 ft. of opening in the framing, and a height of 8½ ft. of clear working space beneath the horizontal bar of the frame; and it is, without doubt, the largest hammer at work in Great Britain.

ON THE BURNING OF WELSH STEAM COAL IN LOCOMOTIVE ENGINES.

By Joseph Tomlinson, Jun., Esq.

(Illustrated with Wood Engravings.)

The use of coal in locomotive engines having become almost the rule, the writer offers the following results of a series of trials he has made with the steam coals of South Wales in locomotive engines upon the Taff Vale Railway, in comparison with the best descriptions of coke to be had in the same district; as there has hitherto been a difficulty in the use of that description of coal for such a purpose, almost amounting to prohibition, from the fact that in all previous trials a failure has resulted from the burning of the fire-bars. This failure of the Welsh steam coal in locomotive engines has been hitherto attributed to the fire-bars becoming clinked over; but the results of the trials described in the following paper appear to show that the failure has arisen from an entirely different cause, and one that can be completely obviated.

The writer was originally driven to the use of coal alone for carrying on the traffic of the Taff Vale Railway in January last, in consequence of the continued strike of the colliers in the Rhondda Valley, where the coking coal is obtained. Previous to that time little or no coal had been used in the locomotives, owing to the good quality and low price of the coke; and from the idea that coal could not economically compete with coke for the heavy work of this

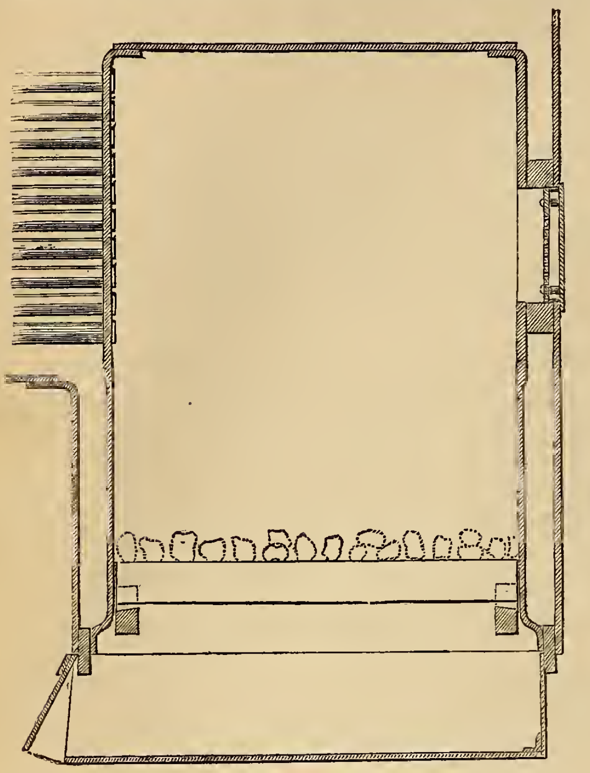


Fig. 1.

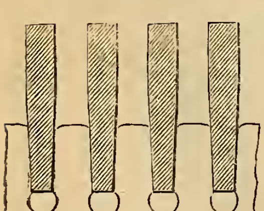


Fig. 3.

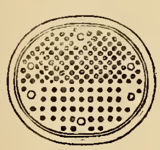


Fig. 4.

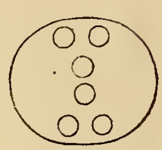


Fig. 5.

to run 100 miles. After careful consideration of the subject it was decided to use only one description of coal; the preference was then given to the steam coal over the bituminous, as being more pure in its composition and smokeless; and after attentive observation and trials the Aberdare Four Feet Vein coal was chosen. With this coal it was found that the least damage was done to the fire-bars, and the best result obtained by working the engine with a very thin fire, say, not exceeding 9 in. with a moderate load, and slightly thicker as the load increased, not however exceeding 15 in. any case. In working with a light train, or down hill with a loaded train, it was found advantageous to keep even a more shallow fire than 9 in.; for the blast being very light (as little or no traction is required down hill on this railway), the supply of steam could not be kept up unless the air were admitted with little difficulty; it is however necessary to be prepared in case of being stopped, and therefore a bright fire was a desideratum which could not be obtained unless it were kept thin.

The injury to the fire-bars was, however, still a great item, notwithstanding all the care that could be bestowed on them; for it is difficult to get a number of men to attend implicity to rules which give them more trouble than they have previously been accustomed to. The writer was therefore induced to try an experiment by covering up the entire surface of the bars with small pieces of fire-brick, not exceeding 3 in. cube, and putting the fire on them, so as to prevent the direct action of the fire on the iron of the bars; and it was found that from the clean nature of the coal no bad result took place in the generation of steam, while the bars now received little or no injury.

Fig. 1 is a longitudinal, and Fig. 2 a transverse section of a locomotive fire-box, Fig. 3 a section of the bars at large. In Figs. 1 and 2 are shown a layer of broken pieces of fire-brick on the bars: this plan has beeu generally adopted, but with the partial substitution of clinker from stationary engines instead of fire-brick alone. In has completely obviated the difficulty of the bars being burnt, and a set of bars will now last on an average four months, running about 100 miles a day. It is also attended with a beneficial result; the small coal, instead of passing directly into the ash-pan unconsumed, adheres partially to the red-hot brick and clinker, and is consumed; aud notwithstanding that the Welsh steam coal falls readily to small, and has little, if any, binding property, the engines cau run 100 miles without cleaning out the ash-pan. Another description of coal containing a larger per-centage of ash has also been tried for getting up steam and making the first fire to start with, which clinkering slightly on the bars most effectually protected them from burning: the use of this coal was however limited to 5 cwt. per day for each engine.

To place the engine more out of the coutrol of the men, the plan was adopted which has been in use on other engines, of perforating the shield of the fire-door and drilling five or six 2-in. holes in the door itself, as shown in Figs. 4 and 5, so as to admit a little air above the fire; this was found useful not only in assisting combustion, but also in preventing the blast from lifting the small particles of coal, and thereby choking the tubes.

Having so far succeeded in efficiently working the traffic entirely with coal, and finding the engines were working the trains with a smaller weight of fuel than they had previously done, the writer was disinclined to return to coke without good reason, after the experience he had had. A series of experiments was therefore made to test the commercial value of each description of fuel. The particulars of these experiments are giveu in Tables I. to VII. (appended). Tables I. and II. show the results of experiments made with an engine working the regular mineral trains, with Aberdare Four Feet Coal and Rhondda Valley Best Coke: and Tables III. and IV. give the experiments with the same coal and coke with a special train of thirty-five loaded coal waggons weighing 269 tons, run at the regular speeds of the ordinary trains of about $11\frac{1}{2}$ miles per hour. Table V. gives experiments with various fuels with a special train of forty loaded coal waggons weighing 314 tons, run at a speed of 20 miles per hour up the hill, and 12 miles down (12 miles per hour being the limit down hill with loaded trains). Tables VI. and VII. show the results of experiments with Bastard Steam Coal and Aberdare Nine Feet Coal; the former of these has a larger per-centage of ash and more bituminous property, the only objec-

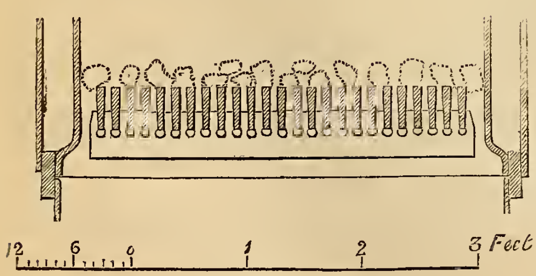


Fig. 2.

Fig. 6.

line, and also from the known difficulties to be overcome iu its employment. The transition from coke to coal being sudden and unprepared for, it became necessary to watch the matter closely, so as to determine which of the various descriptions of coal would answer the purpose best, and to arrange its treatment; more especially as at the outset, from the various qualities of coal that had to be used, the fire-bars were contiuually being burnt out, and seldom could be made to last two days without passing through the hands of a smith to be separated and straightened; even then, several bars a day were totally destroyed in each engine, some engines having had two entire new sets a day

tion to its use being the smoke; it does not burn the bars and is fully as economical as the pure steam coal.

The whole series of experiments were made with the same engine and by the same engineman. The engine is of the following dimensions: cylinders 16 in. diameter and 34 in. stroke; six wheels coupled, 4 ft. 6 in. diameter; firebox, 3 ft. 6 in. square, by 4 ft. 10 in. high; 156 tubes, 13 ft. 3 in. long by 2 in. diameter, and No. 11 to 14 wire gauge thickness; safety-valves loaded to a pressure of 110 lbs. per sq. in. Fig. 6 is a section of the Taff Vale Railway, showing the several gradients along the line, the mean gradient being1 in 309.

Table I.—*Experiments with Welsh Steam Coal. Aberdare Four Feet Vein.*

	Date of Experiment.	Distance run.	Speed in running Miles per hour.	Pressure of Steam per sq. inch.	Weight of Train. Up.	Weight of Train. Down.	Weight of Train. Mean.	Coal consumed. Total.	Coal consumed. Per mile.	Coal consumed. Per ton per mile.	Water evaporated. Total.	Water evaporated. Per lb. of coal.	Remarks.
	1858.	Miles.	Miles.	lbs.	Tons.	Tons.	Tons.	lbs.	lbs.	lb.	lbs.	lbs.	
Regular	May 4.	88	11·5	110	150·6	424·5	287·6	3752	42·64	·148	26312	7·01	Weather fine.
	May 5.	88	11·5	110	124·7	520·7	322·7	2968	33·73	·105	22126	7·46	Do.
Mineral	May 6.	88	11·5	110	79·9	531·8	305·8	2744	31·18	·102	23472	8·55	Do.
	May 8.	90	11·5	110	113·3	342·7	228·0	3640	40·44	·177	25116	6·90	Do.
Trains.	May 11.	100	11·5	110	242·9	632·4	437·6	5320	53·20	·122	41412	7·78	Do.
	May 12.	100	11·5	110	229·8	590·5	410·2	4872	48·72	·119	39319	8·07	Do.
	Average	92·3	11·5	..	156·9	507·1	332·0	3883	42·07	·127	29626	7·63	

Table II.—*Experiments with Welsh Coke. Rhondda Valley Best Coke.*

	Date of Experiment.	Distance run.	Speed in running. Miles per hour.	Pressure of Steam per sq. inch.	Weight of Train. Up.	Weight of Train. Down.	Weight of Train. Mean.	Coke consumed. Total.	Coke consumed. Per mile.	Coke consumed. Per ton per mile.	Water evaporated. Total.	Water evaporated. Per lb. of coke.	Remarks.
	1858.	Miles.	Miles.	lbs.	Tons.	Tons.	Tons.	lbs.	lbs.	lb.	lbs.	lbs.	
Regular	May 27.	100	11·5	100	255·9	183·6	219·7	5880	58·80	·268	40515	6·89	Slight rain & fair.
	May 28.	100	11·5	85	240·9	257·3	249·1	4928	49·28	·198	36179	7·34	Fine and dry.
Mineral	May 29.	88	11·5	95	114·6	701·0	407·8	3528	40·09	·098	26312	7·46	Fine.
	June 1.	88	11·5	82	92·4	281·8	187·1	2968	33·73	·180	27758	9·35	Fine.
Trains.	June 2.	90	11·5	90	184·3	369·9	277·1	4088	45·42	·164	31096	7·61	Rain.
	June 3.	92	11·5	100	237·2	410·7	324·0	5208	56·61	·175	40963	7·87	Rain and fair.
	Average	93	11·5	..	187·5	367·4	277·5	4433	47·67	·172	33804	7·62	

Table III.—*Experiments with Welsh Steam Coal. Aberdare Four Feet Vein.*

	Date of Experiment.	Distance run.	Speed in running. Miles per hour.	Pressure of Steam per sq. in.	Weight of Train.	Coal consumed. Total.	Coal consumed. Per mile.	Coal consumed. Per ton per mile.	Water evaporated. Total.	Water evaporated. Per lb. of coal	Remarks.
	1858.	Miles.	Miles.	lbs.	Tons.	lbs.	lbs.	lb.	lbs.	lbs.	
Special Trains of 35 loaded Coal Waggons.	July 8	100	11·6	110	269	3752	37·52	·139	29601	7·89	Rain 1st trip. Fair 2nd trip.
	July 9	101	11·2	110	269	3532	34·97	·130	30050	8·51	Fine and dry.
	July 10	101	11·8	110	269	3612	35·76	·133	30349	8·40	Fine and dry.
	July 12	100	11·5	110	269	3192	31·92	·119	27957	8·76	Fine and dry.
	Average	100·5	11·5	...	269	3522	35·04	·130	29489	8·37	

Table IV.—*Experiments with Welsh Coke. Rhondda Valley Best Coke.*

	Date of Experiment.	Distance run.	Speed in running. Miles per hour.	Pressure of Steam per sq. in.	Weight of Train.	Coal consumed. Total.	Coal consumed. Per mile.	Coal consumed. Per ton per mile.	Water evaporated. Total.	Water evaporated. Per lb. of coal.	Remarks.
	1858.	Miles.	Miles.	lbs.	Tons.	lbs.	lbs.	lb.	lbs.	lbs.	
Special Trains of 35 loaded Coal Waggons.	July 14	100	11·2	110	269	3536	35·36	·131	26910	7·61	Fine and dry.
	July 15	100	11·3	110	269	3234	32·34	·120	27658	8·55	Fine and dry.
	July 16	100	11·1	110	269	3256	32·56	·121	27658	8·49	Fine and dry.
	July 17	100	11·5	110	269	3328	33·28	·124	29153	8·76*	Fine and dry.
	Average	100	11·3	...	269	3338	33·38	·124	27845	8·34	

* Blow-off cock opened during trip in consequence of priming.

Table V.—*Experiments with various Fuels.*

	Date of Experiment.	Description of Fuel.	Distance run.	Speed in running. Miles per hour.	Pressure of Steam per sq. inch.	Weight of Train.	Fuel consumed. Total.	Fuel consumed. Per mile.	Fuel consumed. Per ton per mile.	Water evaporated. Total.	Water evaporated. Per lb. of fuel.	Remarks.
Special Trains of 40 loaded coal waggons, run at 20 miles per hour up hill and 12 miles down.	1858.		Miles.	Miles.	lbs.	Tons.	lbs.	lbs.	lb.	lbs.	lbs.	
	July 19.	*Coke—Rhondda Valley Best Coke.*	100	16·8	110	314·2	4284	42·84	·136	32292	7·54	Fine and dry.
	July 20.	Coal { Aberdare Four Feet Vein, lump. }	100	16·5	110	314·2	4180	41·80	·133	32292	7·73	{ Slippery 1st trip. Fair 2nd trip.
	July 21.	Coal { Aberdare Four Feet Vein, half lump and half small.. }	100	14·8*	{ 110 80 }	314·2	4816	48.16	·153	34236	7·11†	Fine and dry.
	July 22.	Coal—Newcastle Coal, half small ..	100	15·1*	110	314·2	6020	60·20	·192	31694	5·26	Fine and dry.

* Stopped on road to clean out smoke-box; speed of 20 miles per hour could not be maintained owing to heating of smoke-box.
† Water lost by priming, say 2,542 lbs., making the water evaporated 6·58 lbs. per lb. of coal.

Table VI.—*Experiments with Welsh Steam Coal. Rhondda Valley Bastard Steam Coal.*

	Date of Experiment.	Distance run.	Speed in running. Miles per hour.	Pressure of Steam per sq. inch	Weight of Train. Up.	Weight of Train. Down.	Weight of Train. Mean.	Coal consumed. Total.	Coal consumed. Per mile.	Coal consumed. Per ton per mile.	Water evaporated. Total.	Water evaporated. Per lb. of coal.	Remarks.
	1858.	Miles.	Miles.	lbs.	Tons.	Tons.	Tons.	lbs.	lbs.	lb.	lbs.	lbs.	
Regular	June 5.	100	11·5	95	195·9	489·5	342·7	4256	42·56	·124	33040	7·76	Fine and dry.
	June 7.	100	11·5	78	208·4	414·1	311·2	3920	39·20	·126	34385	8·78	Fine and dry.
Mineral	June 8.	90	11·5	86	104·0	631·8	367·9	3360	37·33	·101	30498	9·08	Fine and dry.
	June 10.	90	11·5	85	159·5	551·1	355·3	3080	34·22	·096	26163	8·49	Fine and dry.
Trains.	June 11.	90	11·5	80	203·7	686·1	444·9	4004	44·49	·100	34983	8·74	Fine and dry.
	June 12.	90	11·5	92	216·7	465·1	340·9	3528	39·20	·115	31993	9·07	Fine and dry.
	Average ..	93·3	11·5	..	181·4	539·6	360·5	3691	39·55	·110	31844	8·63	

Table VII.—*Experiments with Welsh Steam Coal. Aberdare Nine Feet Vein.*

	Date of Experiment.	Distance run.	Speed in running miles per hour.	Pressure of Steam per sq. inch.	Weight of Train.			Coal consumed.			Water evaporated.		Remarks.
					Up.	Down.	Mean.	Total.	Per mile.	Per ton per mile.	Total.	Per lb. of coal.	
	1858.	Miles.	Miles.	lbs.	Tons.	Tons.	Tons.	lbs.	lbs.	lb.	lbs.	lbs.	
Regular Mineral Trains.	August 4.	100	11·5	110	212·7	612·0	412·3	4564	45·64	·111	36478	7·99	Wet and slippery.
	August 5.	100	11·5	110	228·2	381·4	304·8	4382	43·82	·144	37076	8·46	Fine and dry.
	August 6.	90	11·5	110	168·6	555·4	362·0	3878	43·09	·119	30050	7·75	Fine and dry.
	August 7.	90	11·5	110	180·4	898·9	539·7	4388	48·76	·090	36628	8·83	Fine and dry.
	Average	95	11·5	..	197·5	611·9	404·7	4303	45·29	·112	35058	8·15	

The following Table gives the general results of the whole of the experiments, showing the quantity of fuel consumed per ton per mile, the quantity of water evaporated per lb. of fuel, and the average speed of the train during running:—

Description of Fuel.		Fuel consumed per ton per mile.	Water evaporated per lb. of fuel.	Speed in running Miles per hour.
		lb.	lbs.	miles.
Coal—Aberdare Four Feet Vein.....Table	I.	·127	7·63	11·5
Coke—Rhondda Valley Best Coke......	II.	·172	7·62	11·5
Coal—Aberdare Four Feet Vein	III.	·130	8·37	11·5
Coke—Rhondda Valley Best Coke	IV.	·124	8·34	11·3
Coke—Rhondda Valley Best Coke	V.	·136	7·55	16·8
Coal—Aberdare Four Feet Vein, lump....	V.	·133	7·73	16·5
Coal—Do., half lump and half small ..	V.	·153	7·11	14·8
Coal—Rhondda Valley Bastard Steam Coal	VI.	·110	8·63	11·5
Coal—Aberdare Nine Feet Vein	VII.	·112	8·15	11·5

The results in the consumption of fuel showing in all cases slightly in favour of the coal, they may fairly be considered equal; and as the abuse of the engine when burning coal is more easily detected than when using coke, this forms a further advantage in favour of coal. The preference may also be given to coal over coke for the freedom in generating steam, which will allow the blast-pipe to be of larger dimensions than when burning coke. This has been clearly shown, as the engines are now maintaining steam at 100 to 110 lbs. per square inch with coal, with the same sized blast-pipes as were used previously for 80 lbs. with coke; and the fire-bars have also been placed closer together, the air-spaces being reduced from 1 in. to $\frac{5}{8}$ in. Hence the writer thinks it may be concluded that the Welsh smokeless coal may be economically used in substitution for coke; and that where failures have taken place previously, they are to be attributed to the very great heating power of the coal; and that the difficulty with firebars has resulted not from clinker, but from the absence of a proper protection for the iron of the bars, so that with heavy firing the heat has struck downwards and fused the bars themselves.

Nearly all the engines on the Taff Vale Railway are now burning Welsh steam coal entirely; they take with each train a load of 80 empty waggons, averaging $3\frac{1}{4}$ tons each, or 260 tons total, up an average rising gradient of 1 in 309, at from 13 to 14 miles per hour, without any inconvenience.

The composition of the Aberdare Four Feet Vein, the coal now in use in these engines, is

Carbon	90·25
Hydrogen	4·12
Oxygen	2·25
Nitrogen, &c.	2·13
Ash	1·25
	100·00

It is therefore practically coke, and requires only proper treatment for substitution in the place of coke. Another great advantage in the use of this coal over all others in locomotive engines is its almost entire freedom from smoke, thus rendering any plan of smoke-burning unnecessary, not even a steam-jet being required when the engine is standing.

The advantage of slow speed is so distinctly shown in the results obtained that the writer considers this point is worthy of more attention than it usually receives on railways; for a slow speed not only economises the quantity of fuel consumed by diminishing the resistance of the train, but also increases the evaporative duty obtained from it.

(*To be continued.*)

ASSOCIATION OF FOREMEN ENGINEERS.

On the 2nd ult., the usual meeting of the Associated Foremen of Engineers took place at their Assembly-rooms, in the City of London. Mr. Joseph Newton, President, filled the chair on the occasion, and the announcement of a Paper to be read by Mr. Keyte on the "Best Means of producing Heavy Castings in Iron," had the effect of attracting a numerous assemblage of members.

After the ordinary business of the society had been disposed of, Mr. Keyte proceeded to read his promised Paper. He commenced by claiming the usual indulgence granted to novices under similar circumstances, and disclaimed the use of pedantic scientific terms. Plain workshop language he deemed best in describing workshop operations, and that he should use. The whole series of processes involved in the founding of castings of great weight, and wherein strength and density of metal were requisite, were next explained, with all the lucidity which arises from the perfect mastery of a subject. The making of the pattern, whether for a hydraulic ram, cylinder or great gun, with due regard to the difficulties of the moulding department; the best kind of sand for moulding purposes; the construction and management of the melting-furnace; the mixtures of iron best adapted for large castings; the method of pouring; extent of "dead-head" advisable; and, in short, every important and every minute point in connexion with the matter in hand, were elucidated with force and clearness. An excellent feature in relation to this Paper, and one which was of essential service to the writer, were the illustrative diagrams accompanying it. These enabled Mr. Keyte to show at a glance what, in many instances, without them would have required verbal explanations of considerable length to make plain. Altogether, the Association may be congratulated on the production of this valuable contribution to their "Transactions," and, did space permit, we should be tempted to do more than give this brief abstract of it. Much applause greeted Mr. Keyte at its conclusion, and Mr. Stabler, Mr. M. Jones, the Chairman, and others, having joined in a discussion upon some particular points, a vote of thanks was unanimously accorded to that gentleman.

The President announced that Mr. John Briggs would read a Paper before the members at the ensuing meeting, on the first Saturday in May, on the "Concussion of Water," and the agreeable proceedings of the evening terminated.

LITERARY AND PHILOSOPHICAL SOCIETY OF MANCHESTER.

April 5th, 1859.

Dr. J. P. Joule, Vice-President, in the Chair.

The Chairman exhibited several slips of paper having messages inscribed upon them by Professor Thomson's new electric telegraph apparatus. In these specimens the marking consisted of a succession of minute perforations, produced by sparks from an inductive coil apparatus while the paper was gradually drawn through the machine. The sparks are directed to the paper by a fine platina-wire, affixed perpendicularly to a light arm attached to a small magnetic needle suspended within a coil of wire. The directive tendency of the needle is made very great by means of adjacent steel magnets. So long as either no current or a uniform flow passes through the coil, the perforations go on in a straight line. To produce signals, temporary electric currents of longer or shorter duration are transmitted. The magnetic needle carrying the platina wire is thus deflected, causing the line of perforations to assume the shape of a succession of letters V of various width and at various distances asunder, and in this way letters and words are indicated by the use of a given code of signals. The chief advantage of this system of telegraphic recording is that it gives clear legible signals when a "relay" is entirely thrown out of action by inductive embarrassment. It has also the advantage of showing clearly signals superimposed on earth currents. The signal, superimposed either on the large *swell* or *wave*, of induction or of an earth current, is like a ripple seen distinctly on a large wave. The Chairman stated that Professor Thomson had recently discovered the means of giving a surer direction to the electric sparks, and of producing a very considerable increase in the size of the perforations produced by them. He also remarked that the system above described was similar in principle to that employed by Professor Thomson in transmitting the whole of the messages which had crossed the Atlantic from either side. To him, therefore, the merit of having given a temporary success to the Atlantic telegraph exclusively belongs.

A Paper was read by the Rev. Robert Harley, F.R.A.S., entitled The Method of Symmetric Products, and its Application to the Finite Algebraic Solution of Equations.

This Paper is divided into three sections. The first contains a systematic exposition of Mr. Cockle's Method of Symmetric Products, with illustrations of its power and efficiency when applied to the lower equations. In the second, the author discusses the resolvent product (θ) for quintics, and defines a new cyclical symbol (Σ'). He shows that θ has six, and only six, values, and that when any one of these values vanishes, the equation of the fifth degree admits of finite algebraic solution: its roots are actually exhibited. Mr. Cockle's new solvible form is verified, and shown to include, as particular cases, the quadrinomials of De Moivre and Euler. The third section contains a direct calculation of the equation in θ. The coefficients are followed, one by one; the calculation being carried on by means of the cyclical symbol Σ', which is shown to possess peculiar working properties. The resulting sextic is found to coincide with Mr. Cockle's equation, obtained by a wholly different method, which was laid before the Society a few months ago in his "Researches in the Higher Algebra. The author notices the steadiness with which the Method of Symmetric Products mounts up to the higher equations, and concludes by expressing his belief that the equation in θ—the verification of which has involved prodigious labour—will be found to be a canonical equation in the theory of quintics.

ROYAL INSTITUTION OF GREAT BRITAIN.

ON MAGNESIUM, CALCIUM, LITHIUM, AND THEIR CONGENERS.

WILLIAM ODLING, M.B.

CHARLES WHEATSTONE, Esq., F.R.S., Vice-President, in the Chair.

The majority of the metals known at the beginning of the present century were observed to occur naturally in the earthy or oxidised state. The alkalies and earths proper, from their many analogies to the metal-yielding earths, were long suspected to be the oxides of certain unknown metals, whose tendencies to maintain the oxidised condition were stronger than those of any metals which had up to that time been isolated. This conception was first verified by Sir Humphrey Davy in 1807, and has since been abundantly realised. From their characteristic property of neutralising acids to form salts, the earths and alkalies received the name of bases, and the metals eventually extracted from them became known as basic or basylous metals. Some of these metals, particularly those obtained from magnesia, lime, and lithia, have only of late been procured in quantities sufficient to allow of a demonstration of their properties.

The highly basylous and the commercial metals are alike obtained by three principal processes—namely, electrolysis, precipitation by means of another metal, and reduction by charcoal at a red or white heat.

1. *Electrolysis.*—Very many metallic compounds, when submitted to the action of a galvanic current, are decomposed, with a deposition of metal upon the negative pole of the battery. Although a cheap electrolytic process has been devised for the extraction of copper from its ores, yet, altogether, electrolysis is too expensive to admit of employment for the mere separation of the commercial metals. It is, however, largely applied in the fine and useful arts for the production of different metals in certain required forms, as in the well-known operations of electrotyping, electroplating, &c. The liquid state, which is an essential condition for electrolysis, is usually obtained by dissolving the metallic compound in water; but for procuring the highly basylous metals, this means does not succeed, inasmuch as these metals cannot exist in contact with water. The basylous metals seem, indeed, to be deposited upon the negative pole; but, simultaneously with their production, they are acted upon by the water of the solution, and thereby converted into the state of caustic alkali. The liquid condition is consequently attained by means of fusion. Certain salts of the basylous metals, usually the chlorides, from their ready fusibility, are melted in suitable crucibles, and then submitted to electrolysis; this is the only mode by which the metals calcium and lithium are obtainable.

2. *Precipitation of one metal by another.*—This process is largely employed on a manufacturing scale. At the mines of Freyburg, metallic silver is obtained by agitating chloride of silver with scrap iron. The iron enters into combination with the chlorine, and turns out the silver. At the Royal Mint, silver is obtained by immersing plates of copper into solution of sulphate of silver. At the Cornish mines, considerable quantities of copper are annually obtained by immersing pieces of iron in solutions of copper. These processes are performed in the wet way. As an example of the dry way, we may adduce the metal antimony, which is made commercially by fusing sulphide of antimony with scrap iron. The iron turns out the antimony and unites with the sulphur. Similarly the metals aluminium and magnesium are prepared by fusing their respective chlorides with metallic sodium; the sodium unites with the chlorine and turns out the aluminium or magnesium. To obtain metals by this process of substitution, it is ordinarily necessary that the metal used to expel another must be more basylous than the metal expelled; hence it is that sodium is required for the production of magnesium. With the exception of potassium, which is much more expensive, sodium is the most basylous of the metals; it even serves to displace the quasi-metallic grouping of hydrogen and nitrogen, known as ammonium. Amalgam of sodium, introduced into a solution of chloride of ammonium, forms chloride of sodium and amalgam of ammonium. But these most highly basylous metals, potassium and sodium, afford remarkable exceptions to the law that basylous metals replace less basylous metals. Thus, although when sodium is heated with hydrate of iron, the sodium expels the iron, as might be anticipated, yet when hydrate of sodium and iron borings are heated together, a reverse action takes place, and the iron turns out the sodium, as in Gay Lussac's process for the production of that metal. This reciprocity of results is only an extreme instance of a tolerably general law. In a similar manner, though mercury displaces silver from argentic nitrate, yet silver displaces mercury from mercurous nitrate. Though copper displaces silver from argentic sulphate, yet silver displaces copper from cupric sulphate. Though cadmium displaces copper from cupric chloride, yet copper displaces cadmium from cadmic chloride, &c., &c. Some of these results appear to depend on Brodie's law of homogeneous affinity; thus, when cadmium is deposited upon copper, we have the reaction,

$$\overset{+}{Cu}\,\overset{-}{Cu} + \overset{+}{Cd}\,\overset{-}{Cl} = \overset{+}{Cd}\,\overset{-}{Cu} + \overset{+}{Cu}\,\overset{-}{Cl}$$

3. *Reduction by Charcoal.*—This is the most usual means adopted for the production of metals on a manufacturing scale. Brunner's process for obtaining potassium and sodium is an exact counterpart of the commercial process for obtaining zinc; in each case the metal is evolved in the gaseous state, or distilled, from a heated mixture of its carbonate with charcoal. The same reciprocity exists between sodium and charcoal as between sodium and iron. Thus, carbon decomposes oxide and carbonate of sodium to form carbonic oxide or anhydride (acid). But sodium, heated in carbonic oxide or anhydride, liberates carbon, and forms oxide or carbonate of sodium. Indeed, chemical reactions are not absolute, but conditional. Under reversed condition we obtain reversed results.

Magnesium.—Chloride of magnesium is the source from which the metal is usually obtained. Becquerel succeeded in procuring octahedral crystals of magnesium by the electrolysis of a solution of chloride of magnesium. But the metal is preferably obtained by electrolysing the fused salt. Matthiessen employs a common tobacco-pipe for the purpose: the bowl is filled with fused chloride of magnesium, or rather with a mixture of chloride of magnesium and chloride of potassium, which is more easily prepared than the pure salt. The negative pole, to which the magnesium attaches itself, consists of an iron wire passing through the pipe-stem. The positive pole consists of a pointed piece of gas-carbon dipping into the fused mixture of salts. Magnesium is, however, obtained most abundantly by heating its chloride with metallic sodium, as before referred to. The sodium turns out the magnesium, which collects in globules that may be melted together under a flux of low density. Magnesium is a solid metal of a silver-white colour. Its appearance contrasts favourably with that of aluminium, which has a decided bluish tinge. The freshly-cut surface of metal is highly lustrous; it does not tarnish in dry air, and acquires only a film of oxide in moist air. Magnesium is but very slowly acted upon by pure cold water. It decomposes boiling water somewhat rapidly with evolution of hydrogen. Its specific gravity is 1·75. It is about one and a half times lighter than aluminium, and is indeed the lightest of all metals that are permanent in the air. One cubic inch of platinum balances $12\frac{1}{4}$ cubic in. of magnesium, and only $8\frac{1}{4}$ cubic in. of aluminium. At ordinary temperatures magnesium is somewhat brittle, and may be readily cut or filed. It is neither very malleable nor very ductile; but, at an increased temperature, may be hammered into plates, and drawn, or rather pressed, into wire by Matthiessen's process. The metal is placed in a small hollow steel cylinder, having a hole drilled in its anterior face. Through this hole the metal is forced in the form of wire, by means of a press, acting through the intervention of an iron piston, fitting into the hollow of the cylinder. Magnesium is readily volatile—so much so, indeed, as to allow of its being purified by distillation in an atmosphere of hydrogen. It is a highly combustible metal, and burns brilliantly in air or oxygen with a pure white flame. A magnesium wire, ignited at one end, will continue to burn through its entire length. Magnesium corresponds closely in its properties with zinc, and through zinc approximates to cadmium. The atomic weight of zinc is the mean of the atomic weights of magnesium and cadmium; and the atomic volume of zinc is the mean of the atomic volumes of magnesium and cadmium.

Calcium.—This metal does not result from the action of sodium upon chloride of calcium, but is obtainable only by the electrolysis of that salt, rendered a conductor by fusion. It is a solid metal, of a somewhat yellowish colour. It is highly lustrous, but tarnishes quickly in the air, and gradually becomes converted throughout into oxide of calcium or lime. It decomposes cold water rapidly with evolution of hydrogen. Its specific gravity is 1·58. It is moderately hard, malleable, and ductile. It has not been volatilized When heated to redness in the air, it burns with a scintillating flash; but, in consequence of its want of volatility, does not inflame. Calcium bears to its congeners—strontium and barium—relations similar to those which magnesium bears to its congeners—zinc and cadmium, save that the members of the calcic family are associated rather by an equality, and those of the magnesium family by a gradation of properties. The atomic volume and atomic weight of strontium are respectively the means of the atomic volumes and atomic weights of calcium and barium. Despite many points of resemblance, the differences between calcium and magnesium are well marked. Thus, magnesium and zinc are volatile and inflammable metals, permanent in the air, scarcely acted upon by cold water, and obtainable by treating their respective chlorides with sodium. Calcium is neither volatile nor inflammable, is quickly oxidised in the air, is rapidly acted upon by water, and is not obtainable by treating its chloride with sodium. The hydrate of calcium is soluble in water—the hydrates of magnesium and of zinc insoluble. Hydrated chloride of calcium, when heated, evolves water; but the hydrated chlorides of magnesium and zinc evolve chlorhydric acid, &c.

Lithium is a very sparingly distributed element. It occurs native, in proportions varying from 3 to 12 per cent., in certain complex silicates, fluorides, and phosphates, and is obtained in the metallic form by the electrolysis of fused chloride of lithium. The specific gravity of lithium is 0·59. With the exception of bodies in the gaseous state, it is the lightest substance in nature. It floats upon every known liquid. One cubic inch of platinum balances $36\frac{1}{2}$ cubic in. of lithium. Lithium is a white-coloured lustrous metal, rapidly oxidised by exposure to the air. It is softer than lead, and may be cut with a knife, or squeezed between the fingers. It is readily obtained in the form of wire, by Matthiessen's process. It melts at 180° C, and at a higher temperature volatilizes. When heated to redness in the air, lithium takes fire, and burns with a brilliant, highly luminous, white flame, that is in curious contrast with the crimson colour which its compounds impart to the flame of ordinary combustibles. The presence of lithium in any substance is usually ascertained by means of this crimson-coloured flame, which, however, is altogether irrecognisable in the presence of even a small quantity of sodium salts, owing to the intense yellow-coloured flame which they produce. Cartmell has recently pointed out a ready mode of detecting the lithium coloration, even in the presence of a large excess of sodium salts—namely, by viewing the flame through a layer of the blue solution of sulphate of indigo, which completely cuts off the yellow rays due to the sodium, but allows the uninterrupted transmission of the crimson rays due to the lithium. Gradational relations, similar to those of magnesium, zinc, and cadmium, exist between lithium, sodium, and potassium. In the solubility of its carbonate, in its degree of oxidisability, and in many other properties, sodium is strictly intermediate between its two congeners. De la Rue has observed, that metallic sodium, from its inferior degree of oxidisability, may be preserved unacted upon in an aqueous solution of caustic soda. The atomic weight and atomic volume of sodium are respectively the means of the atomic weights and atomic volumes of lithium and potassium.

Lithium undoubtedly belongs to the same family as sodium and potassium. Like these two metals it is soft, readily fusible and volatile, highly oxidisable, and of lower specific gravity than water. Moreover, its hydrate and carbonate are sensibly soluble in water. But having regard to the totality of its characters in the free and combined states, and particularly to the properties of its hydrate, carbonate, and phosphate, it appears that the analogies of lithium to calcium and magnesium respectively, are scarcely less marked than are its relations to the true alkaline metals. It seems, indeed, as if the metals lithium, calcium, and magnesium stood upon the same level, and that while the gradation of lithium, sodium, and potassium, diverged in one direction, the gradation of magnesium, zinc, and cadmium diverged in another.

Lithium.	Calcium.	Magnesium.
Sodium.	Strontium.	Zincum.
Potassium.	Barium.	Cadmium.

Or, we might say, that as regards their properties, potassium, barium, and cadmium, are highly specialised forms, while lithium, calcium, and magnesium are degraded or general forms which, from the comparative absence of special characters, approximate to one another. The sums and means of the atomic volumes of the three groups of elements are shown below:—

	Sums.	Means.
Mg. Zn. Cd.	14·2	4·7
Ca. Sr. Ba.	24·9	8·3
Li. Na. K	37·4	12·4
	3)76·5	3)25·4
	25·5	8·4

The atomic volume of the calcic family is observed to be exactly intermediate between those of the lithian and magnesian families. Similar relations exist between the atomic weights of the three groups.

When, irrespective of these curious numerical relations between the different elements and groupings of elements, we find the groups characterised by distinctive but correlated properties, and the members of the groups associated by community of characters, and separated by gradational differences only, we perceive that the possession by each element of its own special properties is not an accidental endowment, but is a necessary result of the development of one general comprehensive plan.

INSTITUTION OF CIVIL ENGINEERS.

(Continued from page 73.)

These and other considerations, induced attention to the apparently superior power of puddled steel to support the forces by which the ordinary forged masses of wrought-iron were fractured, especially as by the employment of smaller and lighter masses, greater strength in shafts, &c., could be secured. One special peculiarity appeared to be that in the heaviest pieces of this material, the internal structure was as fine and close in the grain as it was in the smallest bar. The elastic limit was above that of the best wrought-iron, and the elasticity was so much more perfect that it might be trusted almost up to the elastic limit of about 15 tons per square inch, and in forged masses it possessed this strength nearly equally in every direction. The range of extension, at the elastic limit, was rather greater than that of fibrous-hammered bar-iron, of excellent quality. Beyond the elastic limit, with equal increments of strain, its extension did not rapidly diverge and increase as in wrought-iron; it slowly increased up to about 20 tons per square inch, and gradually and evenly enlarged up to the breaking point, which was not reached within 42 tons per square inch, and was often found to reach 48 tons per square inch.

This puddled steel was not like cast steel, a harsh, rigid, and glassy material, which possessed, indeed, enormous cohesion, but yet was so rigid and unaccommodating to forces, variable in direction and impulsive in character, as to deprive it of trustworthiness in practice. On the contrary, puddled steel appeared to combine the great strength of cast-steel with the ductility and perfect elasticity of the best wrought-iron. Its resistance to pressure was very remarkable, being more than double that of harsh crystalline wrought-iron, and more than than three times that of the best fibrous wrought-iron in bars, or plates. Thus it might be safely used, under a passive strain or load of 20 tons per square inch, after allowing a margin of one-half for security.

Puddled steel would thus evidently become an important practical adjunct in the construction of machinery, in building vessels of light draft of water, and for artillery of the largest calibre. It possessed also the peculiarity of resisting corrosion much better than wrought-iron plates, and thus had an additional value for shipbuilding.

An investigation was then entered into of the causes of the manifestly greater strength of the integrant slabs than of the large forgings built up from them; but it was shown that this quality did not extend to the boiler plates, which acquired a certain amount of rigidity. This was also possessed by the puddled steel, and it was anticipated that it would ultimately be extensively employed for the boilers, and even the fire-boxes, of the locomotive boiler.

From this investigation nothing of a certain character could be concluded as to any fixed relation between the strength and the specific gravity of the several sorts of iron experimented upon. The weakest irons—those from the heavy forgings—having generally the highest specific gravities, though always lower than their integrant faggot bars. Thus it appeared that specific gravity was a charcteristic to which too great importance had, hitherto, been attached in relation to strength both in cast and in wrought-iron. It was modified, increased, or diminished, by the mechanical operations of manufacture to an extent far beyond anything that chemical difference of constitution produced, and, in reality, it afforded no criterion of strength, although in fibrous irons it did afford an index of their degree of extensibility for equal sizes.

The modulus of elasticity deducible from these experiments, from the mean results of the great forgings, was 12,559,680 lbs., or 3,771,675 ft. for iron forged in great cylindrical masses. The mean specific gravity being taken at 7,663, the weight of 1 ft. long by 1 in. sq. of this iron was 3·33 lbs. The modulus for great forged rectangular masses, or slabs, was 18,079,200 lbs., or 5,478,545 ft.; the specific gravity being 7,610, and the weight of a bar, 1 ft. long and 1 in. sq., 3·30 lbs. Both fell far below the modulus for good English bar iron, of 7,550,000 ft. as deduced by Tredgold, or even below 6,787,878 ft. as deduced by Edwin Clark from Eaton Hodgkinson's experiments.

The author concluded his Paper by recording the obligations he was under to Messrs. Horsfall and to Mr. Clay, of the Mersey Steel Works, Liverpool, and to the officers of the War Department, and the Royal Arsenal, Woolwich, for the facilities afforded to him during his investigation.

The Paper was profusely illustrated by diagrams and specimens of iron and puddled steel.

At the meeting of February 22, some specimens of timber, recently imported from the North West Coast of America, were exhibited by Mr. G. R. Burnell. It was observed, that the quality and dimensions of this timber, which came from near Vancouver's Island, and the district bordering upon British Columbia and California, appeared to be such as to justify rather more than the passing notices hitherto given in the technical journals of the metropolis.

There were now lying in the commercial docks between 50 and 60 logs of this timber, upwards of 100 ft. in length, and measuring at least 22 in. on a side. There was one log in particular, which was 129 ft. long, die, square, perfectly straight and sound, apparently free from dead knots, or shakes, and measuring 39½ in. on the side, at the middle of its length. At the butt end it was nearly 4 ft. sq., and at the taper end it was about 2 ft. 4 in. sq.; and it contained 1,302 cubic ft., or upwards of 26 loads.

No experiments had been made on the specific gravity, or on the strength of this timber; but from the manner in which it floated, it would appear that its specific gravity was about the same as that of yellow pine. The strength would appear to be equal to that of the best Crown Memel, if an opinion might be formed from the way in which some planks had been bent, and the conditions of elasticity indicated under such circumstances.

For bridge-building, roofing, and scaffolding purposes, it was suggested, that this North Western American fir would be of great value, on account of its length, and its remarkably uniform character.

Some light spars of the same kind of wood, about 119 ft. long, and 15 in. diameter at the butt end, had also been imported from the same coast.

The price of the very long spars was, at present, about 6s. per foot cubic; this was high, but no doubt it would hereafter be diminished. The price of ordinary lengths was nearly the same per foot cube as that of the best Crown Memel deals.

Attention was directed to the number and closeness of the annular rings, which indicated that the trees were of slow growth; and it was thence inferred, that the wood would probably be durable.

It was suggested that it would be desirable to make some experiments of an authentic character on the properties of this timber.

March 8, 1859.

Joseph Locke, Esq., M.P., President, in the Chair.

The whole of the evening was occupied by the discussion of Mr. Mallet's Paper On the Co-efficients of Elasticity and of Rupture in Wrought-iron in relation to the Volume of the Metallic Mass, its Metallurgic Treatment, and the Axial Direction of its Constituent Crystals.

It was explained, that Tredgold and other experimenters only gave the absolute forces which would tear a bar asunder. In the present investigation an endeavour had been made to ascertain the amount of permanent elasticity possessed by the metal, as well as the point at which it would become actually ruptured.

It was contended that the drawings exhibited gave a very imperfect representation of the piling of the iron for large forgings, and that hence the author had been led to draw erroneous conclusions. With regard to the manufacture of the two monster mortars, 36 in. in diameter, and capable of throwing a ball weighing about 30 cwt., it was remarked that their merits, as forgings, were extraordinary. At first, owing to large rents in the centre of the core, the forgings were failures, but after a little experience had been gained, the second forgings were quite successful. In the manufacture of these monster guns, they were built up in seven distinct layers, the forging occupying seven weeks. So far from any deterioration or crystallisation taking place, the metal was improved by its long-continued heating and working; and the metal in the heart of the gun was found to be of greater strength than the bar iron of which it was composed, being perfectly homogeneous, strong, and tough. A series of experiments, for testing the correctness of the process, showed that the ordinary manufacture of bar iron, by working and re-working several times, had its limits. As a proof that the deductions in the paper were incorrect, it was asserted that engineers had one universal rule for the manufacture of forgings, whether large or small, and it was not found that the shafts of 1,000 H.P. engines were more liable to fracture than those of 100 H.P. This was practical evidence that the metal was not more deteriorated in large forgings than in small, from the length of time it was exposed to the action of the fire; indeed, no one portion was so exposed for any great length of time. It was urged, that scrap-iron, or any other highly-refined iron, was the worst material for the construction of large forgings. It was considered that a strong, fibrous, fresh-puddled iron was superior in every respect, as the ordinary workings required in the process of forging would be sufficient to improve it to the average maximum of strength; whereas a highly-refined iron had already reached the highest point as regarded strength, so that it was more likely to be injured by additional working. There was another reason why scrap-iron should not be used for the manufacture of forgings. Scrap-iron was composed of many different qualities of iron, all having their own special welding points. When worked together, one portion, which was less refined, was too much heated, and consequently deteriorated before the more highly-refined portions were at a welding heat; so that there was the difficulty either of burning the one or of being unable to weld the other. Again, the specimens selected by the author for trial, and which he said were weaker than the original iron composing the forging, were not taken off in the direction in which the fibre was laid for strength—in which it was intended that the strain should be borne. Now, forge-masters always laid the grain of the metal in the direction in which the strain would ultimately be applied; whereas, the samples experimented upon, had been cut transversely to that direction.

With regard to the new material, "puddled steel," it was believed that it was destined to work a complete revolution in almost all matters in which iron had hitherto been used. It had been proved to possess at least double the tensile strength of the best wrought-iron, and the elastic limit of the material was also greater in proportion to the breaking strain. A piece of this material had been subjected to a strain of 32 tons per square inch for seventeen consecutive hours without exhibiting the slightest appearance of elongation. Subsequently, a bar 4 ft. in length, and 1 in. by $\frac{3}{10}$ths in. in section, had been exposed to a strain of 45 tons per square inch, when it was found that an elongation of $\frac{15}{20}$ths of an inch had taken place. Upon the weight being removed, $\frac{13}{20}$ths of this elongation were recovered, showing that the elasticity of the material had not been destroyed. On another occasion the elongation amounted to $\frac{21}{100}$ths of an inch, and returned to $\frac{20}{100}$ths of an inch. Upon a second application of a strain of 56 tons per square inch, the bar was broken, the elongation having been $\frac{37}{100}$ths of an inch. In other experiments the bars broke at 55, 56, and 60 tons, and one bore the enormous strain of 87 tons per square inch. To attain this favourable result, which it was believed might eventually be accomplished as a rule, it was essential that great care should be taken in the selection of the materials, and great pains in the manufacture. It was entirely a question of good workmanship and good machinery; and a new manufacture of this sort would, for years to come, require the utmost attention and solicitude. In Germany, where this great improvement in metallurgy had been first introduced, a large number of manufacturers commenced making puddled steel; the consequence had been, that an amount of bad material had been thrown upon the market, which had brought puddle steel into disrepute for a time, and from which it had scarcely yet recovered. This was to be feared in this country, when the German patent had expired.

It was further contended, that if the calculations in the paper had been based upon forgings, faggotted in the manner delineated in the drawings, they were of little practical utility. It was stated that large forgings, weighing 20 tons, and measuring 24 in. in diameter, for engines of 1,000 H.P., were now made at several places in England without flaw or defect, except perhaps a small sand speck upon the surface, which was not of any consequence. When Nasmyth's hammer was first introduced, the plan was suggested of having the lower forge block made of a **V** shape, and the bottom part of the hammer so small as to strike only upon the upper centre of the periphery of the forged piece. The mass was thus struck in three places, and the tendency was to force the material to the centre, so as, in fact, to render the heart as solid and homogeneous as the other portions.

In reply to an inquiry as to whether the rents in large iron forgings, spoken of in the paper, would not also be liable to occur equally in the puddle steel, it was said that in forgings of iron large crystals or grains were developed, which would not be the case in similar masses of puddled steel; and that in the latter, the aggregation of grains or crystals was not increased by the agglomeration of the mass. These rents might be accounted for by the differential contraction of the metal. In the principal case referred to, the outside of the collar, which was 4 ft. in diameter, cooled more quickly than the remainder of the forging, and these internal rents took place after it had left the hammerman's hand. It was stated, that plates of puddled steel had already been supplied from the Mersey works for twenty-one vessels, some of them of 250 tons burthen, and 38 ft. beam. The thickness of the plates for the vessels for Indian river navigation was one-eighth of an inch, and none had yet been made or called for as a mercantile commodity of greater thickness.

In conclusion, a hope was expressed that on an early occasion the subject of puddled steel would be again brought under the notice of the Institution; for if it possessed the qualities ascribed to it, it was worthy of the most careful consideration of engineers who had to design large railway structures, as well as for other purposes. In India and distant colonies, to which so much material had necessarily to be transported for public works, anything which would tend to reduce the weight to be carried, and consequently the freight, was a point of the highest importance. The Institution was, therefore, under great obligation to the author for having elicited this information.

March 15, 1859.

Joseph Locke, Esq., M.P., President, in the Chair.

The Paper read was, Account of Experiments upon Elliptical Cast-iron Arches, by Mr. T. F. Chappé, M. Inst. C.E.

These experiments were undertaken, at the request of Mr. W. H. Barlow, M. Inst. C.E., for the purpose of ascertaining, practically, the safe load to which elliptical cast-iron arches might be subjected, as well as the most economical distribution of the metal. The intrados of the arches was, in all cases, a segment of an ellipse, in order to obtain the greatest headway at the haunches. The experiments were, in each case, conducted upon two ribs, placed 2 ft. apart from centre to centre, and resting on cast-iron abutment pieces, keyed-up tight against the springings. Diagonal stays and longitudinal struts were also introduced to prevent lateral motion.

The first experiment was made upon a model, one-fourth the real size, of one arch of a bridge, intended to be erected over the river Trent, near Newark. The (model) arch had a clear span of 14 ft. 6 in., and a rise of 16 in.; a camber of $\frac{1}{4}$ in. being given in fixing the halves together. The sectional area of the arch, at the crown, was 2·43 in.; that of the curved rib near the springing 2 in., about midway between the springing and the crown 1·75 in., and of the spandrel 1·34 in. The weight of each arch was 1 cwt. 2 qrs. 22 lbs.

The other experiments were made upon a model, one-sixth the real size, of an arch, erected over the Gloucester and Stonehouse and Great Western Railways, at Standish, 6 miles from Gloucester. The dimensions of the model were—span, 13 ft. 10$\frac{3}{4}$ in., and rise 1 ft. 10 in. The sectional area, at the crown, was 1·25 in., of the curved rib near the springing 1·055 in., about midway between the springing and the crown 0·993 in., about the middle of the upper rib, 0·883 in., and of the spandrel 0·57 in. The weight of each arch was 3 qrs. 26 lbs.

The following pressures were given as those to which the arches were subjected in these experiments:—

Experiment.	Ultimate Load.		How Distributed.	Pressure per square inch of Sectional Area.	
				At Crown.	At Smallest Section.
	Tons.	Cwt.		Tons.	Tons.
No. 1	30	10	Uniformly.	8·52	11·83
No. 2	18	0	Ditto.	6·80	8·58
No. 3	12	0	{ Partially removed from the haunches. }	4·54	5·72
No. 4	5	0	On one haunch.	2·36	2·98
,,	3	12	At centre.	2·93	3·70
No. 5	3	14	Ditto.	3·00	3·85

In the first experiment the ultimate pressure was not reached. In the second and third experiments, one-half arch was out of line laterally, beyond what would be permitted in practice, and was wanting in that assistance which would have been afforded in the number of ribs required for the width of a bridge, so that the ultimate pressures indicated were below what such arches might be estimated to bear. This was also the case in the two last experiments in which the castings were faulty, and the tests were such as were not likely to occur in practice. It was thought that cast-iron arches, of the form experimented upon, might safely be considered capable of bearing a pressure of between 8 tons and 10 tons per square inch of section. From the position of the fractures, it was believed that the spandrels were too weak, in proportion to the size of the arches.

The communication was accompanied by several Tables, showing the deflections on the application of the different loads.

March 29, 1859.

Joseph Locke, Esq., M.P., President, in the Chair.

The whole of the evening was occupied by the discussion commenced at the last meeting, of Mr. Jackson's Paper, On the Melbourne Gravitation Water Works.

It was remarked, that there was a vast number of instances in this country of the collection of water, in a similar manner to that adopted at Melbourne, from drainage areas, generally of a mountainous character, in which the water was received into artificial reservoirs, of sufficient capacity to equalise the irregular rainfall of many years in succession. The present mode of treatment was rather the result of experience than of original reasoning, which for the most part had been erroneous. The method of procedure was this:—First, the extent of the drainage area was ascertained; secondly, the amount of rainfall was arrived at by taking an average of a number of years' observations in the neighbourhood; and, thirdly, the quantity of rainfall that could be collected into any reservoir, which it was practicable to make in the district, had to be considered. The capacity of the reservoir should be proportioned to the population to be supplied, and its area was usually about one-twentieth part that of the water-shed. It was almost impossible, by means of reservoirs, to govern vast floods, and when they occurred an uncertain quantity of water would flow over the waste weirs and be lost. This loss was usually estimated at 10 per cent., or, with a rainfall of 50 in., 5 in. There was also to be deducted the amount lost by evaporation. This, it had been found by experience, might be assessed at 15 in. in this country, so that there could be collected about 30 in. of rainfall. The size of the reservoir to receive and make that quantity available differed in different parts of the country. In Lancashire, where the rainfall was about 48 in., the reservoir should be capable of storing 140 days' supply. In Cumberland, where the rainfall amounted to 60 in., 120 days' sufficed; but in the eastern parts of England, where the rainfall did not exceed 22 in., 200 days' supply should be provided for. As to the amount to be supplied, it was believed that if the waterworks were well managed, and care was taken to prevent waste, 16 gallons per head per diem were sufficient for all sanitary, manufacturing, and domestic purposes; or, where the manufactures were in excess, then from 18 gallons to 20 gallons might be allowed. Where the internal fittings, particularly those called sanitary, were not properly looked after, then the waste would cause that amount to be increased from 30 gallons up to 60 gallons per head per diem; and in New York it was reported to be 90 gallons per head per day. The laxity which prevailed as to the internal fittings leading to this great waste was alike destructive to the interests of those who supplied the water, as well as to those to whom it was supplied, for in many parts of England a scarcity was already beginning to be experienced.

With regard to the particular works under discussion, it was felt that, as the rainfall seemed to be less than in England, and the area of the reservoir to be one-fourth that of the water-shed, and as the evaporation from that large surface, as well as from the land, must, from the statements made in the Paper, nearly approach the whole supply, a want of water was likely soon to arise. There could, therefore, be little hope of any large quantity of water, adequate to the requirements of the future population, being permanently obtained from the same source. In reference to the fracture of the pipes, 33 in. in diameter, laid through the embankment, it was observed that the same thing had occurred under an embankment, less than 12 ft. in height, of a reservoir near Prescot, for the Liverpool Waterworks.

Fully one-third of the pipes so placed, which were 44 in. diameter, and excellent castings, were broken; and the fractures invariably occurred at the top and bottom. It was remarked, that cast-iron in the form of a pipe would stand little external or unequal pressure. If ruptured when in use, the water would escape into the embankment, and if it found its way to the back of the puddle, the embankment would be torn down, and the water in the reservoir be set free. It was not, therefore, desirable that large pipes should be laid under an embankment, where they would be subject to a considerable pressure of earth. It was mentioned incidentally, that all plans for conveying the sewage of London through pipes in an embankment, with an unequal pressure of earth upon them, were opposed to experience, and would result in inevitable failure. Then again, the Paper stated, that the diameter of the main had been gradually reduced, throughout its length, from 30 in. at the commencement to 24 in. at the end. For this there was no apparent reason; and although that plan had been adopted in some of the old water-works in England, it had long since been abandoned.

It was observed, that when a town was to be supplied with water by surface collection, the first point to be ascertained was the average rainfall over the entire gathering ground, and then the proportion available for storage, which was dependent upon the varying conditions of the rainfall. At Bombay it had been estimated at six-tenths. In the construction of dams for impounding water, it was believed, that sufficient attention had not been paid to making them consistent throughout; hence failures arose from their not being water-tight. This was to be attributed, chiefly, to their being raised by the earth being tipped from waggons. At the Edinburgh waterworks all waggons were excluded, carts only being allowed, and the banks were formed in layers 6 in. thick, each layer being thoroughly indurated and punned. It was a matter of importance, that the best system of constructing dams should be practised, so as to allow of their being made as high as was consistent with safety, as a little extra height added greatly to the capacity of the reservoir. It seemed to be generally admitted, that there was great waste in the water supply; for although 20 gallons per head per diem were usually allowed, yet not more than from 5 gallons to 7 gallons per head per diem were used. Opinions were divided as to what became of the difference; whether the loss occurred in the houses, or in the mains; but it was thought that the latter was the chief source of waste, and at all events the former could, in most cases, be checked by the use of meters.

From experiments which had been made with a Dalton's gauge, it was argued that as much as four-fifths of the entire rainfall in this country were lost by evaporation from the surface of the land. This result was corroborated by gauging a neighbouring river, when it was found, that the discharge of the river did not much exceed the proportion of rain which percolated through the soil of the gauge.

It was contended, that experiments upon a large scale did not show that the amount of evaporation in this country was nearly so high as had been stated; much more rain being impounded, year by year, than such a statement would lead to the belief. In constructing dams over a loose, alluvial bottom, it was essential to go below it for a foundation, and with a rocky bottom, seams, fissures, and uprising springs must be especially guarded against. The Holmfirth embankment was said to have been made rotten by a spring in the centre. In one case which was mentioned, the springs were collected in a puddle trench, and the water carried into a vertical well of brickwork, rising therein to the level of the adjoining river. It had been a general practice to carry culverts and outlet pipes through the deepest part of embankments; but it was believed that, under no circumstances, should an outlet pipe be placed in any portion of the "made" embankment. There should be a vertical shaft or inlet tower, into which the water should be admitted by valves, and the outlet pipe from thence should be made by tunnelling, or side cutting, in the solid; so that the impounding dam might not be liable to the interference of water.

Allusion was then made to works for conducting and storing water in the East, particularly in India and Asia Minor. It seemed that in many cases the natural springs had been sought out, the water being conducted in earthenware pipes, provided with ventilating shafts, settling wells, wash-out places, and other appliances as perfect as could be devised at this time. The lines of aqueducts for the supply of Constantinople were also described. It was thought that the plan of gathering water and conveying it through earthenware pipes to a common, strong, service reservoir, was one that might be followed where the springs were tolerably permanent, and in some situations it might be preferable to the use of an impounding reservoir.

It was asserted, in reference to the enormous waste in the distributing apparatus of towns, that at least two-thirds of the supply to London were lost. Where the supply was regulated by ball-cock, the ball was often deliberately unscrewed, and the water run out of the cisterns. Leaky pipes and taps, and especially leaky mains, were likewise the cause of much loss.

With regard to the Melbourne Water Works, it was remarked, that they appeared to be dependent upon the drainage area of 5,200 acres. Now, if the statements in the Paper were to be credited, there would seem only to be a rainfall of 6 in. or 7 in. over that area available for the water supply, after deducting the loss by evaporation. This might suffice for 100,000 persons; but as the population of Melbourne was fast increasing, it was almost impossible that a continuous supply could be afforded for many years from this collecting area. It was true that the drainage area of the river Plenty was given as 40,000 acres, which would amply meet the demands of Melbourne for many years to come, but it did not appear that the river had any connection with the water-works. As to the question of the parallelism of the mains, it was agreed that, under certain circumstances, when a main was entirely open as an outlet, and was discharging with its full force, the line of pipes might be tapered. But that was not the condition under which water was sent through pipes for the supply of a town. The pipe was not open at the ends, and the resistance to be overcome was simply that occasioned by the friction of the water moving along the pipe. It was the same throughout, and therefore the parallel figure was the proper one. Towns situated near mountainous districts could not be supplied by streams in a minimum condition, as they were at present appropriated by mill-owners, by bleachers, by paper-makers, by dyers, or by some or all of these trades. This was particularly the case in Lancashire and the West Riding of Yorkshire. If the streams were taken for the water-works, then these parties must still be afforded a regular supply. The reservoirs should be made sufficiently large to equalise all the storms which the country was subject to. Occasionally there might be an excess of downfall, resulting in floods as large as three hundred times the minimum volume, as had been stated; but it must be borne in mind that the minimum volume was about one-sixteenth, or even one-twentieth of the mean volume. It had been ascertained, as the result of practice, that generally about one-third of the water utilised was given to the mill-owners and others, and the remaining two-thirds went to supply the inhabitants generally of the town. It had also been found that for a supply of 20 gallons per head per diem, reservoirs capable of containing one hundred and forty days' consumption in the North-west of England, and from two hundred to two hundred and twenty days in the North-east of England, were sufficient. Only two instances of complete exhaustion, except where the drainage area was manifestly too small for the population, had been known to take place, and the cause, in these cases, could be readily explained. They both occurred on the east coast of England: one at Boston, which arose from 40 gallons per head per diem being allowed to be drawn from the reservoir instead of 20 gallons per head per diem; and the other at Newcastle, where the storage was not at the time sufficient, a new drainage area not having came into operation. It had been said that the Liverpool main was too large, not for the amount of water required, which was delivered with the greatest regularity and precision, but because when a pipe of that magnitude burst, it usually did a great deal of damage. Repairs were also difficult of execution, the materials being heavy and inconvenient to handle; and if an accident should happen, then the supply might be cut off for a day or two. A plan had been submitted to the Corporation, for two mains, each of 32 in. diameter, instead of one of 44 in. diameter, to be laid 200 yards or 300 yards apart. This it was found would increase the expense by £7,000, and on its being put to the vote by the Corporation, there was a majority of two in favour of one line of pipes.

After the meeting, Mr. Siemens (Assoc. Inst. C.E.) exhibited a machine of his invention, manufactured by Messrs. Guest and Chrimes, for joining lead and other pipes, by pressure only. The machine consisted of a strap of wrought iron, in the shape of the letter V, and of three dies, two of which were free to slide upon the inclined planes, while the third was pressed down upon them by means of a screw, passing through a moveable cross-head, embracing the sides of the open strap. The pipes to be joined were placed end to end, and a collar of lead was slipped over them. The collar was then placed between the three dies, and the pressure was applied, by means of a screw-key, until the annular beads or rings, projecting from the internal surface of the dies, were imbedded into the lead collar. The machine was then removed, and a joint was formed, capable of resisting a hydraulic pressure of 1,100 ft. The security of the joint was increased by coating the surfaces previously to their being joined with white or red lead. The advantages claimed for this method of joining lead or other pipes, over the ordinary plumber's joint, were the comparative facility and cheapness of execution, as the cost of a joint of this description was said to be only about one-third or one-fourth that of the plumbers' joint. A machine of a similar description was also used for joining telegraphic line wires, a specimen of which was likewise exhibited by Mr. Siemens.

April 5, 1859.

JOSEPH LOCKE, ESQ., M.P., President, in the Chair.

The first Paper read was, ON A NEW SYSTEM OF AXLE BOXES, NOT REQUIRING LUBRICATING, AND WITHOUT LIABILITY TO HEATING, by M. Alphonse de Brussaut.

The Author first recapitulated the liability to accident, arising from inattention to the constant greasing of the ordinary axle-boxes and journals of carriages and of machinery, the inconvenience of accumulating dust and grit on the bearings, and the friction and wear and tear arising from these causes. He then reviewed the numerous inventions and attempts to remedy these evils, showing that none of them had hitherto successfully abolished the necessity for the expensive and uncleanly use of some lubricating matter. He next proceeded to describe the system which he had introduced, and had applied somewhat extensively, in France, to various classes of machinery in which the use of grease had hitherto been considered indispensable. The new apparatus was described to consist of a series of four, six, eight, or any other convenient number of cylindrical rollers, of the length of the journal, retained at certain distances apart from each other, yet still united by elastic bands of vulcanised india-rubber. These rollers, thus united, and placed around the journal, would be set in motion by the pressure of the axle, without the possibility of collision, with, or friction against each other, or of rubbing upon the surface of the journal, or of the bearing, and thus avoiding, as much as possible, any friction or opposition to the motion of the journal. The action of rolling being thus substituted for sliding, there could not be any abrasion of the substances, and lubricating became unnecessary. The machines so fitted were stated to work with remarkable ease and steadiness, and to be set in motion, and the speed to be kept up, with considerable facility. No inconvenience had been experienced from the fracture of the elastic bands, and shafts, making 450 to 500 revolutions per minute, worked perfectly well, without any sympton of heating.

The reasons for this action were stated in a plain and comprehensive manner, by showing that, in moving a body of an octagonal form along a plane, the action must be either by sliding or by rolling; in the former, lubrication was necessary, whereas in the latter, the presence of any lubricating matter would be prejudicial. Extending the latter principle to the cylindrical form, which was merely a body having an indefinite number of sides, it was evident that, by retaining these cylinders apart, by means of the elastic bands, so to avoid friction against each other, or upon the journal, or the bearing surface, a practically perfect rolling motion would be obtained; and it was contended, that by M. Brussaut's system, the two material results of rapid rotation without heating, and a complete suppression of the use of grease, in all journals of machinery, were arrived at.

On the Permanent Way of the Madras Railway, by Mr. Bryce McMaster, Assoc. Inst. C.E.

It was remarked, that two leading features in the construction of railways in India were the cheapness of those works entirely dependent upon native labour, and the resources of the country, and the expense of those dependent upon England for the supply of materials. Among the latter of these was the permanent way, almost every part of which had, as yet, to be furnished from England. Thus, the portion of the Madras railway, from Madras to Arcot, being a length of 65¼ miles, had been constructed for £6,000 per mile, of which amount the permanent way alone had cost upwards of £3,000 per mile. On this portion of the line the earthwork, for a distance of 25 miles, was for a double line, and on the remainder for a single line only. All the bridges and culverts were for a double way. There was only a single line of rails laid throughout.

The permanent way on the portion of the line above indicated was laid with the double-headed rail, weighing 84 lbs. to the yard, in lengths of 20 ft. The rails were fish-jointed, and six sleepers were used to each rail length. The chairs, wooden trenails, and keys, were all of the ordinary construction. West of Arcot, the line was laid with rails weighiug 65 lbs. to the yard. These rails were laid on seven sleepers, to the same length of 20 ft. The gauge was 5 ft. 6 in.

The expense of freight, from England to Madras, for the first portion of the line, was very heavy, owing to all the materials having been sent out during the time of the Russian war. A reduction in these charges, as well as in the weight of the rails, might be expected to diminish the cost of the remaining portion of the line; although the greater distance to which the materials would have to be led, as the works were pushed on into the interior, would add to the cost as the line advanced.

At the commencement of the undertaking, tenders were invited in India for the supply of chairs, fishing-plates, bolts, and nuts; but the prices gave no ground for hope that the Indian iron could compete with the English, or that the Indian railways could look for any considerable supply from local sources. But what the country could supply was material for sleepers, as its forests and jungles afforded a great variety of hard and durable woods, well adapted for the purpose. On the Madras railway, twenty-eight different kinds of wood had been used; all of which, with few exceptions, had been found to answer well, when carefully selected. Although few woods were not attacked by the white ant, while lying exposed, and the sap wood in particular was much eaten away, yet in two years after the trains began to run, there was not a case known of a sleeper being attacked in the road. The vibration of the passing trains, and the frequent opening out of the ballast by the workmen, seemed sufficient to prevent the attacks of this universally destructive insect. Many woods were also liable to the attacks of other insects, which bored holes into them; but the sleepers, when covered with ballast, appeared to be free from their depredations. Creosoted fir sleepers, sent out from England, were found to be very durable; but their cost at Madras was 8s. 6d. each, or 9s. 6d. each when led 50 miles to the works, while the sleepers procured in the country varied in price from 4s. to 6s. 6d. each. A few thousand half-round Sâl sleepers were kyanised, experimentally, with corrosive sublimate, at a cost of 6d. per cubic foot; but they were not found to be more durable than those of the same wood, when unprepared. In the neighbourhood of Arcot, granite blocks were used, but not to any great extent, on account of the roughness and rigidity of the road. Near the coast, one mile of line was laid with laterite, but the blocks were found to split, and their use was consequently abandoned. Some native-made keys and trenails were used, but the former were not pressed, and although they did very well in wet weather, in the hot season they shrank so much as to be unfit for use. The trenails, which were of teak, answered very well. In laying the road at first, the natives were found, as in almost every other kind of work, intelligent and apt, when care and patience were taken in their instruction.

The damage to the line from settlements and slips, from the effects of the monsoons, had been much less than was anticipated, and one monsoon of extraordinary severity, having shown all the defects, it was confidently expected that little damage would be done in future; and that the line would be maintained as cheaply as its construction had been inexpensive.

April 12, 1859.

Joseph Locke, Esq., M.P., President, in the Chair.

The whole of the evening was occupied by the discussion of Mr. McMaster's Paper, On the Permanent Way of the Madras Railway.

It was remarked that, for India and other similar countries, the ordinary chair and sleeper road was not yet ascertained to be the best that could be adopted. In such cases it was desirable to aim at obtaining the smallest number of pieces, simplicity of parts, and avoiding complicated fittings. The arrangements should be made with a view to guard against peculation, as well as to the best mechanical construction, for the natives were apt to steal fishing plates and bolts. It was contended, that the single-headed rail, fixed directly upon the sleepers, and with a sufficiently broad flange to prevent injury to them, was preferable. This form of rail had been extensively used in Germany, and in the United States of America, aud the application of the "fish" rendered the joiuts much more secure, and the surface more uniform. It was urged that the quality of the materials and the machinery to be sent to India and other distant places should be carefully attended to, as the heavy charges for freight and shipment formed a large portion of the expense. In this view it was thought that the double-headed rail, first introduced by the President, provided it was so laid as to be capable of being reversed, possessed great advantages. It was believed that rails weighing 60 lbs to the yard, to which an additional hammeriug had been given during the process of manufacture, would answer well for lines where very high speeds were not essential, and that their use would be attended with economy.

(*To be continued.*)

DENNET'S IMPROVEMENTS IN BAYONETS.

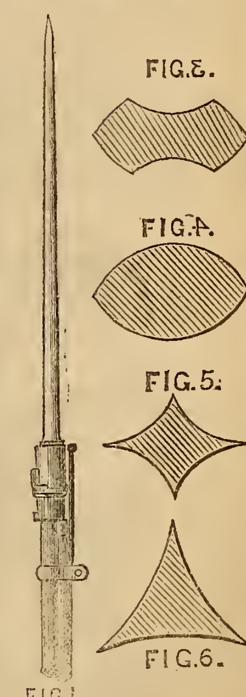


Fig. 2.

The accompanying illustrations—Figs. 1 to 6—exhibit views of bayonets for small arms, designed by Mr. Dennet, the representative of Col. Colt, to meet certain disadvantages which pertain to the ordinary form of bayonet, and the mode of fitting and using it.

It consists in forming bayonets of a lozenge, rhomboidal, or elliptic section, the sides of which forms may be grooved out, and bayouets so formed, instead of being fixed upon the musket, carbine, or rifle, as heretofore, are so fixed, that the sharp edge is coincident with the longitudinal axis of the arm. The practice has heretofore been to expose one of the flat or grooved faces of the bayonet to the line of discharge, or flight, of the bullet; this has been found extremely prejudicial to correct firing when the bayonet is fixed; as, from the re-action of the explosive force of the powder between the concave, or flat surface of the bayonet aud the ball, the latter is caused to diverge from the correct line of flight.

Fig. 1 is an elevation of the muzzle of the piece, fitted with a bayonet.

Fig. 2, a side elevation of the bayonet, showing the manner in which it is applied, and its relative position with the stock.

Fig. 3 is a section of a bayonet to an enlarged scale.

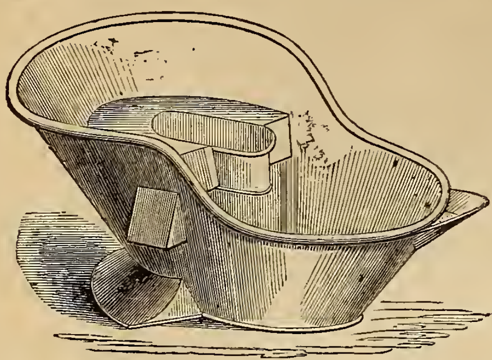
Fig. 4 is a section of another form; and

Fig. 5 is a sectional view of another variety of bayonet. These sections are supposed to be taken relatively on the line A B, of Fig. 2.

Fig. 6 is a section of the ordinary form of bayonet.

OXLEY'S PATENT MULTUM-IN-PARVO BATH.

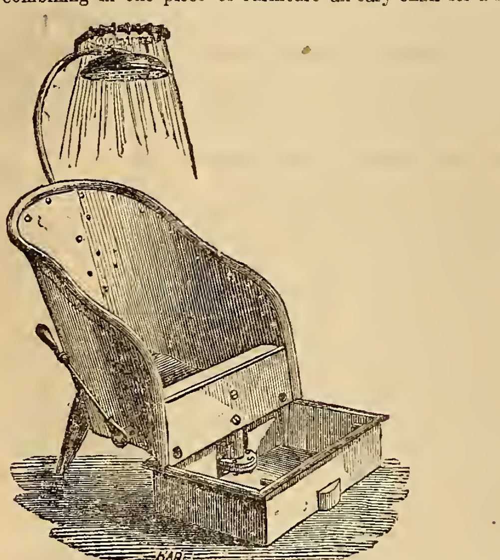
The patent Multum-in-Parvo Bath combines, in a remarkable degree, the various conveniences of a sponge bath and hip bath, a foot bath, a bidet, and a nursery bath. The bather is enabled to perform a complete ablution in a sitting posture with ease, luxury, and comfort, without the trouble of stooping for the water, and can have the feet immersed in hot water at the same time cold or tepid water is applied to the surface of the body, thus avoiding the danger of cold to the feet; and by taking out the seat containing the bidet, you have a roomy and convenient hip bath, or a good nursery bath.



In a former Number of THE ARTIZAN we gave a description of another modification of Oxley's Patent Bath, and to which description and illustration we refer our readers.

GRIFFITHS' PATENT BATH.

MR. ROBERT GRIFFITHS, of screw-propeller notoriety, informs us, that having had his attention called to the subject of the necessity for improved apparatus for bathing the human body, by the notice of Oxley's Multum-in-Parvo Bath, which appeared some time ago in this Journal, he set about inventing something which should be more generally useful than any other form of bath in use, combining in one piece of furniture an easy chair for a bed or



dressing room, with a foot, hip, sponging, or shower bath. The above illustrates Mr. Griffiths' contrivance. Curiously enough, both Oxley's and Griffiths' Patent Baths are manufactured by the same firm—Messrs. Griffiths and Browett, Bradford Street, Birmingham.

NOTICES TO CORRESPONDENTS.

J. G. (Seville.)—Received with thanks.

J. R. D.—Write intelligibly, and we will endeavour to supply you with the information you appear to require.

Z.—1st. Messrs. Rennie and Sons designed, built, and engined the gunboats for the Indian rivers. 2nd. We advise you to apply to some of the agents for the sale of steamships, whose names may be found in the "London Directory;" or apply to Messrs. Newbon and Smith, 63, Fenchurch-street, City, who may have something to suit you. Send us your address.

D. J. (Toulon)—We believe that the concern you mention is in the market. Address the Executors, at the works in Salford.

J. JOHNSTON (Brighton) and RUBY (Macclesfield).—Silk conditioning is a matter we were ignorant of until your inquiries caused us to apply to Professor Crace Calvert, who has kindly furnished us with the information, which we hope to find room for elsewhere in the present Number; but should we be unable to find space, we will forward a slip to each of you upon your forwarding your respective addresses.

G. OSBORN (Gravesend).—We cannot inform you where "Ames' Universal Squares" can be obtained in England; perhaps the manufacturers of those instruments will, on perusing this reference to them, communicate with you direct.

"ARCHIMEDES."—Why ask such questions of us? Apply to the "Dispatch," or the "Sunday Times."

TRURO.—Write to Mr. Evan Hopkins, C.E., Maida Hill, London.

J. ROBERTSON.—Sig. J. Aguirre, 9, Great Ryder Street, St. James's, will translate the documents for you.

R. BACH.—What you inquired for some time ago will be given shortly.

T. LAW (Strabane).—We hope you have received the information which you required.

J. A. C. (Chelmsford).—We have been looking up the subject and are surprised to find how little there is that is practically useful published. What we advise you to do is to write to Robert Hunt, Esq., F.R.S., Geological Museum, Jermyn Street, St. James's; he is more thoroughly acquainted with the subject—philosophically and practically—than any one we are acquainted with.

J. N. (Glasgow).—Your letter, which was wrongly addressed, did not, in consequence thereof, reach our hands until just before going to press; the remainder of the Paper in question is not the only one which we have been compelled to omit, but which, although in type, cannot, we fear, be inserted this month.

REVIEWS.

Engineering Precedents. By B. F. Isherwood, Engineer-in-Chief of the U.S. Navy. London and New York: Balliere.

IT is always difficult to obtain reliable information on the performance of steam ships, and it frequently happens that the most important items are omitted, such as the actual displacement of hull, area of the midship section, mean pressure on pistons, position of throttle-valve, &c.; in fact, it often occurs that, by the omission of one single particular, the information actually given is comparatively useless.

Speaking generally, our transatlantic brethren are more practical and precise in book-making than ourselves, giving less of algebraical formula, and more of plain dimensions, weights, &c.

Engineering conservatism should not, of course, obtain in a Republican country, but in England it is almost a part of ourselves, and its effects are too evident in our literature both standard and periodical. There is, however, a strong liberal opposition arising, that will counteract, and ultimately destroy, this barrier to free interchange of experience.

The title, "Engineering Precedents," is a promising one, and as long as particulars are correctly given, no description of engineeriug work deserves greater encouragement. We are sadly in want of a more extended collection of *results*, treated analytically and synthetically, and we are thankful to receive intelligence of our own performances, though, as in this case, it may come to us by the way of New York.

It appears that Mr. Isherwood, the Engineer-in-Chief of the U.S. Navy, was in China during a portion of the years 1857 and 1858, and whilst there collected information on the working of the engines of some English gun-boats, dispatch steamships, screw steamships-of-war, and steam transports. This information is clearly given, together with the particulars and results of some comparative experiments made in America between the paddle and the screw.

There is one particular feature in this work which deserves special notice—it is the attempt to analyse the distribution of power given out by a marine engine.

What is termed the indicated horse power is the gross power exerted, and includes friction, slip, and propulsion; and it is, of course, desirable to know what per-centage of the gross indicated power is utilised in propulsion. This information is given in detail in the case of each ship referred to, and elaborate comparisons are made, upon the assumption that this distribution of power is correctly stated.

The gross indicated H.P. is divided under five heads:—Friction of the engine, *per se*, friction of the load, cohesive resistance of the water to the screw surface, slip of screw, and propulsion of the ship.

There is a common sense character in this distribution, provided the data for each of the divisions can be relied on as correct. On this point there is much doubt—as no clear explanation is given of the principles on which the friction of the engine, *per se*, or the cohesive resistance of the water to the screw blades, are estimated.

In the case of the 60 H.P. gun-boats the friction of the engine, *per se*, is assumed at $2\frac{1}{2}$ lbs. in the sq. in. on the pistons, or $6\frac{1}{4}$ per cent. of the gross indicated power.

In the case of the *Ireland* of 120 H.P., the friction of the engine, *per se*, is assumed as $1\frac{1}{2}$ lbs. per sq. in., or rather more than 9 per cent. of the gross indicated power.

We do not assert that there are no reasons for such determination of the friction, *per se*, but the want of explanation on this point admits at once an element of uncertainty that is destructive of the whole scheme.

The friction of the load is fairly assumed in each case at $7\frac{1}{2}$ per cent. of the net power, resulting from the deduction of the friction of the engine, *per se* from the gross power, but even here it must not be forgotten that a difference in the length of the connecting rods will affect the comparison of the load friction.

The third item in the distribution is of such an uncertain character that much additional explanation will be required before it can be received.

The term *friction* of the screw in the water is objected to, and the "cohesive resistance of the water to the screw blades" is substituted.

But how is this resistance estimated? We will quote the author's explanation on this point, and shall feel obliged if any of our readers can help us in comprehending the explanation.

"From collating a number of experiments I find it (the cohesive resistance) to be 0·45 pound per square foot of surface, moving with a velocity of 10 ft. per second." Again, "it is in direct ratio of the surface, and as the square of the velocity."

What kind of experiments? what surface? how, and at what point, is the velocity estimated?

We must confess to perfect ignorance on these points, and almost to a decided curiosity to know the particulars of experiments for determining this cohesive resistance.

The rule given at Page 114 for calculating the power exerted in the oblique action of the paddle-wheel, must be carefully read to be appreciated.

The slip is of course easily estimated, and the balance of power left after the above four deductions, is the useful effect in propulsion given in H.P., and also in actual thrust on the screw shaft, easily calculated from the H.P.

The divisions of the distribution of power, as proposed by the author, are well chosen, and provided the data for each could be relied on, and easily obtainable, we could not desire a more accurate method of analysing the power given out by marine engines.

The speed of two gunboats is given as 8·38 and 8·26 knots per hour; but it is not stated how that speed was ascertained, although the comparative merits of the machinery in each ship are computed from the small difference of these speeds as a data.

All the calculations are made with the most praiseworthy minuteness, and occupy the bulk of the book.

As the distribution of power and calculations thereon are given with each of eleven ships, there is of necessity much repetition, and the "Precedents," in a strict sense, form but a small portion of the work.

In concluding this notice of "Engineering Precedents," we cannot but acknowledge there is much useful information given, the faults being rather of omission than commission, and we can recommend this work as well worth perusal to all interested in steam navigation.

If, as is hinted, other volumes of a similar character are to follow, much may be done to increase their usefulness, and every care should be taken to give the why and the wherefore for all rules. Nothing detracts so much from the usefulness of practical works as paucity of information on important points.

If space permits we may, in a future number, make a few additional remarks on those portions of the book we have not in this notice had time to allude to.

LIST OF NEW BOOKS AND NEW EDITIONS OF BOOKS.

WORDSWORTH (C.)—The New Joint-Stock Company Law of 1856, 1857, and 1858, with all the Statutes, and Instructions how to Form a Company, and Liabilities of Persons engaged in so doing. 8vo, pp. 140, sewed, 4s. (Shaw and Son.)

JEANS (H. W.)—Navigation and Nautical Astronomy. Part II. Designed for Beginners. Fcp., pp. 284, cloth, 5s. (Longman.)

HENNESSEY (E. J.)—A Manual for Candidates as Mates and Ordinary Masters. 8vo, pp. 70, cloth, 4s. (Simpkin.)

RICHARDSON (T. A.)—The Art of Architectural Modelling in Paper, with Illustrations. 12mo, pp. 110, cloth, 1s. 6d. (Weale.)

ROOFS—A Rudimentary Treatise on the Principles of, and Carpentry, &c. 12mo, pp. 120, cloth, 1s. 6d. (Weale.)

DELOMME (E.)—New Project for the Purification of the Thames, economising £1,200,000; with a Plan. 8vo, pp. 8, sewed, 6d. (Simpkin.)

DENISON (E. B.)—On some of the Grounds of Dissatisfaction with Modern Gothic Architecture. 8vo, pp. 31, sewed, 1s. (J. H. Parker.)

EWART (J.)—A Digest of the Vital Statistics of the European and Native Armies in India, with Suggestions for the Mitigation of Avoidable causes of Sickness and Mortality. 8vo, pp. 192, cloth, 9s. (Smith and Elder.)

FINCHAM (T.)—Directions for laying off Ships on the Mould Loft Floor, with Instructions for Drawing Ships in Perspective, &c. 3rd edition, with Plate, pp. 112, cloth, 25s. (Whittaker.)

FYFE (W. W.)—Agricultural Science applied in Practice. A Text-Book and Tables of Food, Equivalents for Weight and Value. 16mo, pp. 154, cloth, 2s. 6d. (Groombridge.)

MILLER (H.)—Sketch-Book of Popular Geology; being a Series of Lectures delivered before the Philosophical Institution of Edinburgh. With a Preface by Mrs. Miller. Post 8vo, pp. 590, cloth, 7s. 6d. (Hamilton.)

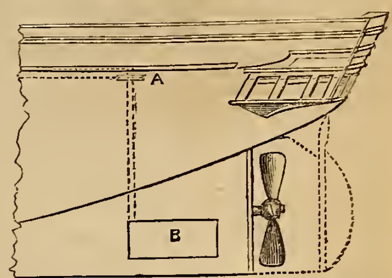
GLASCOCK (W. N.)—The Naval Officer's Manual. 8vo, cloth, 10s. 6d. (Parker.)

CORRESPONDENCE.

[*We do not hold ourselves responsible for the opinions of our Correspondents.*—ED.]

To the Editor of The Artizan.

SIR,—Three or four years ago, Mr. J. Scott Russell built two iron steamers, the *Gothenburg* and the *Oscar*, for the North of Europe Company, and, pursuing that tentative system for which he is so distinguished, and for which steam navigation owes him so many obligations, he substituted for the ordinary rudder a rectangular opening in the lower part of the run, with a *steerer* adapted to fill it, and to move in such a way as to guide the ship. The following sketch will give an idea of Mr. J. S. Russell's experiment:—



The screw thus projected beyond the post, and the steerer, B, when in midships, merely fitted up the space in the run marked "steerer." By means of a tiller, A, as indicated by the dotted line, this steerer was caused to move on a vertical axis, like a rudder.

It may be of great service to state that this substitute for the ordinary mode of steering has not been successful. Both vessels have been altered at the Union Dock, Limehouse, to steer in the ordinary way. This has required an additional piece of keel, stopping up the opening in the run, a new outer post and rudder, as shown by the dotted lines. The *Gothenburg* has been tried since the alteration, and its beneficial effect demonstrated.

Yours, &c.,

A SHIPWRIGHT.

WHO INVENTED THE ARMSTRONG GUN?

To the Editor of The Artizan.

SIR,—The question as to who invented the "Armstrong gun," involves serious considerations for the scientific inventor of plans for England's Government.

That there is something radically wrong in the way inventions are "disposed of" by the War Department and Board of Admiralty, is universally known and complained of; but when will the true interest of the country be rightly considered by those two irresponsible branches of the public service?

England might have been in the full possession of this, and better guns, in the year 1839, had there not been an insuperable barrier placed between the merits of inventions and the inventor; for it was then the joint production of Dr. H. Drake and myself at Glasgow, when that gentleman was under a course of mathematically mechanical naval and military training, for I was then engaged in improving my ordnance inventions, which commenced in May, 1829, while attending, at the request of officers in command of the Western District of Artillery, the practice of cannon with which I had been familiar in both branches of the service from an early age, and for ten years in that war which was brought to a close at Waterloo.

Within two hours of the "Armstrong gun" being made known to me in detail, on the 16th January, I felt it due to Dr. Drake, who resides in the West of England, to claim the priority of invention, as originating with him at the date named. The Secretary-at-War, Major-General Peel, told me that he could not see what Dr. Drake had to do with Mr. Armstrong; when I answered, nothing, as neither he nor myself knew Mr. Armstrong or his invention till it was professionally described to me, before restrictions had been placed on the publicity of the invention, but that we had conjointly invented a gun, literally the same in the principle of breech-loading, and in some of its parts better, and had taken it, with a great number of other ordnance inventions, to Woolwich in 1854, by the advice of distinguished personages, who considered that Dr. Drake should place his inventions at the service of this country, war just then having been declared against Russia.

He came to London expressly, and had an interview with ministers to whom we had been long known, and we were well received by the senior members of the Select Committee, who pronounced it impossible to make breech-loading cannon safe, "as nothing would compensate for the boring out of the breech," although, as it has since proved, we had amply provided for this presumed contingency. The Committee also objected to Dr. Drake's application of lead to projectiles for rifled cannon, "as it would not do to have lead in combination with iron," objections which I overruled "instanter," although I do not approve of the combination, as I am convinced iron projectiles can be made to rotate perfectly without the assistance of lead, and without injury to the bore of the gun, but not on the Lancaster or Whitworth principle, both of which I pronounced objectionable before trial.

Before Dr. Drake's business would allow him to appear before the Select Committee again, as intended, the Duke of Newcastle was appointed Secretary-at-War, and was quickly succeeded by Lord Panmure, and a strange change in the affairs at Woolwich had transpired in the interim. Instead of meeting the senior officers, as expected, to resume the discussion, we had to appear before a "Sub-Committee," composed of young officers, some of which could have had but little knowledge of the use of cannon, and certainly not of the construction of cannon; but the Chairman, of more experience, gave us his attention as a gentleman, and when I asked him if he admitted the principle of loading cannon at the breech "practically safe," he frankly answered, "Yes," giving me to understand at once they had one under special consideration; and I regret to say Dr. Drake and self found it quite out of the question to obtain anything like a just investigation into the merits of our numerous inventions, and we were compelled to retire without the shadow of effecting any good for the public service. The then favoured selection turned out to be the notorious American breech-loading example, the inventor of which gave part of the money obtained at the War Department to my professional friend's "man," as he called him, when he told me the whole six were "not worth more than their weight as old iron," and now so generally known to be the fact; but the money was paid, as Lord Panmure openly declared in the House of Lords, when questioned on this noted subject, because the invention had been "so favourably reported upon by a Select Ordnance Committee." It is very evident the "Armstrong gun" is not to be classed with the American invention, and practice has proved that neither Dr. Drake or self was wrong in considering it safe when we submitted the screw-breech principle, with others, to the consideration of the Senior Select Committee of 1854; but why the Government should be weak enough to make a mystery of the invention—the same as a Colonel at the Proof Department attempted to make a mystery of the Lancaster invention to me when I inspected the first example—must appear to reasonable men unaccountable. But, unfortunately for science and the interest of the country, England's Government do many mysteriously strange things, but which, it is to be hoped, will be shortly abandoned in every branch of the public service.

Up to 1839 my breech-loading cannon were loaded through a slot, before, over, and behind the charge, with a small hole through the breech for the ramrod to adjust the charge, and for a screw-bolt to lock the breech-plug in firing the gun; and it was this which induced Dr. Drake to bore out the breech, and to introduce the screw-plug to load in a direct line with the bore; but at the moment I did not consider it "practically safe," and made several modifications, which I selected expressly from among my numerous examples, to convince Major-General Peel, by his personal inspection, that the "Armstrong gun" had nothing about it worth naming distinct from the plans which he refused to inspect, or to allow them to be inspected by any one in his confidence at the War Office, as I considered it right to request. It must be understood those inventions embrace cast and wrought iron guns, but the base-plug in the slot in the "Armstrong gun" enters the tube with an expanding ring, the same as the Swedish invention, while my plan consists in a solid copper face, entering the bore about 1 in. to break the joint, or a wooden base to the cartridge, for the same object, making the escape of gas impossible, the vent being one and the same in both plans. Respecting the rifling I shall not detail, because my invention secures the rotation of an iron projectile, while the Armstrong plan does not; nor shall I attempt to describe the difference in exploding the projectile by a striker or pellet, which is much better invented by Dr. Drake. My improvements in projectiles are not of a very remote date—commencing in 1845; and it was on inspecting my percussion principle of exploding shell, that Dr. Drake invented the beautiful principle of concussion, lately patented by the inventor of the "Armstrong gun;" but, as before remarked, much more complete, as I have a number of examples to show.

When I brought my projectiles under the inspection of the Committee of 1854, the Chairman told me that he thought everything "had been done that could be done in projectiles," and with this the discussion ended *pro tem.*

Public duty, and the promotion of science, commands me to make this simple explanation, not with any bad feeling towards the gentleman who has been so highly favoured by the Secretary-at-War—far from it—but England's future welfare and our national security must no longer be impeded by party or private patronage of any kind, to the exclusion of that justice which is due to all.

I remain, Sir,

London, April 14, 1859. John Poad Drake, N.M.C.E.

PROPOSED IRON SCREW-TENDERS FOR CONVEYING LIFE-BOATS TO VESSELS IN DISTRESS.

To the Editor of The Artizan.

Sir,—Some two years since we proposed a plan for a Life-Boat, and the main objection was that the present life-boats could not be propelled with sufficient speed by manual power,—a subject that at that time never occurred to us as of importance, as our plan was not adapted for speed but for safety only.

Captain Ward, of the National Life-Boat Institution, said, that if we could devise some means for getting the life-boats to the vessels in distress in a more expeditious manner than at present in use, it would be of the greatest importance.

We now propose to have substantially-built screw-steamers, each to carry two life-boats, to be lowered by Clifford's patent, and to be stationed on various parts of our coast, the vessels to be so constructed as to be suitable for the purpose of towing, by which means they would always find employment and be earning something towards defraying their expenses, if not entirely supporting themselves.

For example, one stationed at Herne Bay might be employed in towing between the Nore and Dover, and by that means never be far from her station, and always ready to render assistance.

The class of vessels we would recommend should be about 92 ft. long, 17 ft. beam, and 9 ft. 4 in. deep, with a draft of 6 ft., and fitted with high-pressure engines of 40 nominal H.P., and the vessels to have watertight compartments.

Now, suppose a vessel to be cast on the Goodwin's, or elsewhere, she makes a signal of distress, the tender immediately puts off with her life-boats, and gets as close alongside as prudent, which need be no great distance, on account of her shallow draft of water; she can then fire rocket-lines over her, haul a hawser on board, and attempt to tow her off, or lower her life-boats, and by that means save the crew; whereas, the shore life-boat would most probably *not arrive* until the vessel became a total wreck, and all hands had perished.

The cost that the tenders might be built for, with engines, life-boats, fittings, and all apparatus complete for sea, and must *substantially constructed*, would be about £3,500 each (at a rough guess).

We would also suggest that if the National Life-Boat Institution, or any other society should adopt our plan, it would be advisable to post notices at various seaport towns, stating that the vessels were employed as tugs; that being known, all captains would prefer to employ them in preference to other tug-boats, and by that means the vessels would always be certain of a sufficient amount of work to defray their expenses.

We must add, in conclusion, that any society, or the corporation of any seaport town that may think of adopting our plan, may be furnished with any particulars or information respecting the same, by applying to us.

Newbon and Smith,

63, Fenchurch Street, London, E.C. Naval Architects.

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c.

Under this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.—Ed.

The City Gas Company and the Corporation of London—[Alleged] Nuisance.—On the 2nd April ult., a summons was heard at the Guildhall Justice-room, against the City of London Gasworks. The prosecution was at the instance of the Board of Conservancy of the River Thames, and it charged the Gas Company with a nuisance caused by the discharge into the river of certain noxious matters, being the refuse of the chemical ingredients used in the manufacture of gas. The liquid analysed was obtained direct from the sewer's mouth, discharging into the river, and prosecution alleged that, in consequence of certain alterations which had been made in the construction of the sewer, the noxious fluid produced could not possibly have come from any other source than the gas works. Dr. Letheby said he had analysed the contents of the bottle produced; he found it contained ammonia and sulphuretted hydrogen in much larger quantities than was usually found in ordinary sewage-water; it also contained sulpho-cyanide, which he had never found present in the contents of other sewers; he also noticed the odour of gas-tar. For the defence, Professor Taylor gave his analysis of the water complained of, and his evidence to its [alleged] deleterious quality was somewhat at variance with that of Dr. Letheby. The magistrate ultimately dismissed the summons, on the ground of the contradictory nature of the medical evidence produced *pro* and *con.*

The Polytechnic Staircase—At the Kingston Assizes (Home Circuit), 4th April ult., an action (Brazier *v.* the Polytechnic Institution) involving a claim for personal injuries arising from the late falling of the "geometrical" staircase, was tried. After a variety of scientific evidence on both sides of the question had been adduced Mr. Justice Wightman left the main question for the jury's consideration as one of negligence, requesting them to say, yes or no to the question, whether the persons employed by the defendants to make the repairs and alterations had exercised the necessary skill and caution to effect that object? The jury ultimately gave as their opinion "that proper skill and caution had not been exercised by the persons employed by the defendants to make the repairs and alterations; and they, therefore, returned a verdict for the plaintiff, with £10 damages." Various points of law were reserved for further consideration.

Negligence in Railway Officials.—At Rochester (1st April ult.), four men employed on the East Kent railway, at Chatham, were charged before the Court Magistrates with having that morning negligently left a carriage on the up-line of railway, at the time the up-express train to London was due, whereby a collision occurred, and the lives of the passengers were placed in jeopardy. From the evidence it appeared that, on the express-train emerging from the Gillingham tunnel, the driver observed a "trolly" standing on the same line of rails, about 300 yards before him. He immediately reversed his engine, put down the breaks, and reduced the speed to about 10 miles an hour, but was unable to stop the train, and the engine ran with great force into the "trolly," which it hurled a great distance. Fortunately, none of the carriages left the line. The accused were all employed on the line, and it was their duty to have removed the "trolly" off the rails, and to have had the line clear at least fifteen minutes before the train was due (at Strood junction at 8·50). One of the accused, the foreman, when he heard the train approaching, appeared to have done something to endeavour to prevent the collision, but it was then too late. Sentence—the foreman to one month; another to fourteen days, and the other two each to seven days' hard labour.

Fastening down Safety-valves.—The Halfpenny Steamboats.—At Bow-street Police Court (28th March ult.), the captain of the *Jupiter*, halfpenny steamboat, was summoned under the Merchant Seamans' Act (at the instance of the Board of Trade), to answer the charge "of having increased the weight upon the valve of his steam-engine beyond the limits affixed by the Board of Trade." The attention of the Surveyor-General of the Marine Department of the Board of Trade had been called to the state of the safety-valve of the vessel in question, plying between London Bridge and the Adelphi; and an engineer had accordingly been sent to examine the boat (on the 17th March last), and the safety-valve was found so wedged and fastened down as to be absolutely useless. The officer represented this state of things to the superintendent of these (halfpenny) boats at the Adelphi station; but was informed that the fastening of the valve was necessary. The Board of Trade, however, had taken a different view of the matter, remembering the serious loss of life occasioned by the explosion on board the *Cricket* (halfpenny) steamer, a few years ago; and hence the present proceedings. Mr. Galloway, engineer, of New Cross, was stating the result of his examination of the *Jupiter* by the direction of the Board, while the vessel was standing off London Bridge, when the magistrate (Mr. Henry) drew the attention of the solicitor to the fact, that the faulty state of the safety-valve was alleged, in the summons, to have been noticed *at the Adelphi;* but that the evidence given related solely to an examination of the boat which took place *at London Bridge.* Unless it was intended to be shown that the valve was seen in the same state at the Adelphi, the case was out of his (Mr. Henry's) jurisdiction. The information must be laid in the City. The prosecution, consequently, broke down.—On the 2nd April ult., the same question came before Alderman Mechi, at the Mansion House, City, the managing-engineer of the Halfpenny Boat Company appearing to the summons. The penalty for a violation of the Act is £100. On this occasion, Mr. Galloway (the engineer-surveyor appointed by the Board of Trade) deposed to his having (on the 17th March ult.) examined the state of the safety-valves of the *Jupiter*, lying at London Bridge; that she usually works at a pressure of 50 lbs. to the square inch, according to the regulations of the Board of Trade, under the Merchant Shipping Act; that the Government valve was fastened down; a piece of wood being wedged in between the lever and the case, which prevented the valve from acting; the two ordinary valves in the boilers were free, and working correctly at a pressure, as indicated by the gauge, of 48 lbs. to the inch. That the effect of fastening down the Government valve is to place the pressure quite under the control of the engineer on board the vessel. That the boiler in question was a locomotive, and had been used on a railway before it was put in the steamboat. That the Government-test of the fitness of a boiler (for steamboats on the river) was by subjecting it, every six months, to trial at double pressure (on the hydraulic principle), and that he believed that this boiler had been working for years on the river, and has been often repaired. For the defence, evidence was produced of passengers by the *Jupiter* having been bespattered with mud and water, which shot out of the Government safety-valve. [Mr. Galloway's previous evidence had shown, that "priming" frequently causes inconvenience, as water and mud are thrown out with the steam; that the Government valve being considerably lower than the other valves, is, therefore, more liable to "prime," but that this may be obviated by working the ordinary valves at a pressure of 5 lbs. less than the Government one.] The magistrate said, he was inclined to believe that, in this case, defendant had acted only for the purpose of remedying a defect in the placing of the Government valve; he should, therefore, only fine him in the penalty of £10 and costs; that there was nothing to show that the defendant had endangered the lives of the passengers; adding, also, his (the magistrate's) opinion, that the Government valve should be raised.

GROUNDING OF H.M. STEAM-SLOOP "ARDENT."—The Court-martial, assembled (12th April ult.) on board the *Formidable*, guardship, at Sheerness, to try the lieutenant of the watch on duty when the vessel ran ashore in the morning of the 24th December last, for alleged neglect to take proper soundings, &c., on that occasion, decided to the effect that there was no proof of such alleged neglect, and the president, accordingly, returned to the officer his sword.

THE [RECENT FATAL] ACCIDENT TO THE PRINCE FREDERICK WILLIAM, MAIL STEAMER.—The Report of the Dover Magistrates, and Nautical Assessor to the Board of Trade (see our last number for announced [general] decision). is to the effect: 1st. That the casualty was not caused by the wrongful act or default of the master, inasmuch as the usual lights are proved to have been exhibited, authorising him to enter the harbour. 2nd. That the loss of life which subsequently occurred [by the life-boat capsizing] appears to have arisen from causes beyond the control of the said master or of any of his crew.

RAILWAY BILLS.—STANDING ORDERS [House of Commons].—On the 11th April ult., Mr. Fitzroy moved (and carried) the Repeal of Standing Order 130—and, in lieu thereof, the substitution of the following:—The Committees on Railway Bills shall direct their attention especially to the following heads of inquiry, and shall receive evidence from the promoters thereon, namely:—1. The financial arrangements proposed (including number of shares, amount of capital, sufficiency of the estimate for the works, &c., &c. 2. The merits, in an engineering point of view, of the proposed railway; the character of the gradients and curves; the number and extent of the tunnels, if any; the planes, if any, to be worked by assistant engines; the crossings, if any, of public roads on the level; and any peculiar engineering difficulties, with the mode proposed for overcoming them. 3. The degree of favour or objection with which the project is regarded by the landowners, and others in the neighbourhood of the proposed railway. Railway committee to report specially to the House whether any Report from the Board of Trade or any Bill has been referred by the House to the Committee; and, if so, in what manner the several recommendations contained in such Report have been dealt with by the Committee: whether it be entered that the railway shall cross, on a level, any turnpike-road or highway; and any other circumstances which, in the opinion of the Committee, it is desirable that the House should be informed of.—Agreed to.

THE STEAM TROOP-SHIP "PERSEVERANCE."—COLLISION with the barque *Ava* (see "Notes and Novelties," present number).—A Court of Inquiry was held, 14th and 15th April ult., at Devonport, to ascertain the circumstances under which this accident occurred. Finding of the Court not as yet promulgated.

WRECK OF THE "JASEUR."—The court-martial assembled (19th April) at Portsmouth, on board the *Victory*, flag-ship, to try the lieutenant, officers, and crew of Her Majesty's gun-boat *Jaseur*, for having lost that vessel on the Baxco Nuevo Reef, in the Caribbean Sea (26th February last), after a lengthened investigation, acquitted the accused from all blame on the occasion.

PAPER OR PARCHMENT?—DECISION.—In the Court of Exchequer, 20th April ult. (Attorney-General *v.* Barry), the Lord Chief Baron delivered judgment in this case, which was argued last term. The defendant, it will be remembered, is a paper manufacturer, and had used a patent invention for the manufacture of an article as a substitute for parchment. On the part of the Crown it had been contended that this article, being made out of the refuse of animal skins, was liable to the higher duty payable on paper, inasmuch as the refuse of the skins was first reduced to a pulp; defendant, on the other hand, contending that it could only be regarded as parchment; and, as such, liable only to the lower duty payable on that material. The Court now held that the manufacture clearly came within the scope of the paper duties, and that judgment should be for the Crown. Judgment accordingly.

RAILWAY ACCIDENT COMPENSATION.—In the Court of Exchequer, 20th April ult., a rule *nisi* for a new trial was granted in the case of Birkett *v.* The Whitehaven Junction Railway Company, tried at the last Assizes for Cumberland, being an action for compensation for railway accident, brought under Lord Campbell's Act by the widow of the plaintiff, to recover damages for his death, and wherein a verdict for £200 had been returned by the jury.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

WE have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "18, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

A NEW TYPE-COMPOSING MACHINE.—The invention of Mr. Robert Hattersley, of Manchester, has been (experimentally) in operation in the printing establishment of Messrs. Bradbury and Evans, Whitefriars. The letters are arranged in rows, on a table; and, by pressure on a key, the desired letter is made to pass down a groove, and into the "composing-stick." The compositor who made trial of it, stated, that after three days' practice, he could compose and "justify," a "stick of matter" in seventeen minutes; the time ordinarily employed to perform that operation being thirty minutes. He could "set up" 3,500 letters an hour: but, that, with a little more practice, he thought he could do 5,000 (the ordinary rate of composition by hand, being about 2,000 per hour:—that mistakes are less liable to occur in setting up the type, than by manual composition; and consequently, less time is spent in correcting. The machine, if successful,* appears not unlikely to have great effect on the printing trade.

THE NEW STEAM CRANE on the east wall of the steam-basin in Portsmouth dockyard will undergo its testing trial in the course of a few days. Steam was got up 7th April ult., for the first time. Messrs. Fairbairn, of Manchester, are the contractors.

BOOTS AND SHOES BY MACHINERY.—At Stafford (and, we believe, elsewhere,) boots and shoes are now made entirely by machinery, the soles being "sprigged" down and securely fastened by a machine invented for the purpose. The specimens of workmanship thus produced are tolerably well executed. Another machine has also been invented, which fastens on the bottoms and heels by means of brass screws, the soles possessing the same elasticity as those made up in the ordinary way by manual labour.

THE EXPORTS OF YARN, THREAD, AND CALICO, during the month of February last (from Hull), were:—Cotton yarn, 4,829,085 lbs.; woollen and worsted yarn, 953,980 lbs.; linen thread and yarn, 1,254,360 lbs.; calicos [plain and printed], 7,604,942 yards.

ROAD-MAKING IN INDIA.—The number of roads opened for traffic in the several Presidencies of India, since the year 1848, is as follows:—In MADRAS, number of first-class roads, 13; length in miles, 2,222; number of miles constructed since 1848, 684; cost of construction and repair since 1848, 36.26.673 rupees. Second and third class roads:—Number of miles constructed since 1848, 3,709¾; cost, 52.46.944 rupees. In BOMBAY, first-class roads, 183 miles; cost of construction, 14.72.995 rupees. Second and third class roads, 3,721 miles; cost, 23.02,709 rupees. In SCINDE, 1,929½ miles of first-class roads: cost, 1.51.560 rupees; and of second and third-class roads, 1,835¼ miles; cost, 1.97.425 rupees. Canals, 223 miles: cost, 2.21.089 rupees. In BENGAL, 64 miles of first-class roads: cost, 10.98.993 rupees; and 389 miles of second-class roads: cost, 4.46.472 rupees; second and third class roads, 3,853 miles: cost, 12.33.776 rupees. In the PUNJAUB, 1,141 miles of first-class roads: cost 95.95.877 rupees; and second and third class roads, 9,285 miles: cost 23.20.196 rupees.

A SELF-ACTING "BASTING APPARATUS" is at present exhibited in the window of Messrs. Field and Son, Ironmongers, Buchanan Street, Glasgow. It is the work of a German, and, of its kind, a good specimen of inventive talent. The "roaster" has attached to it a spoon, which, revolving, dips into a receptacle where the fat runs, and then deposits it into a small perforated pipe, which is placed above the meat being roasted, thus rendering unnecessary the attention of the cook or the kitchen-maid. Motion is obtained from a strong spring, similar to that of a watch, and which is wound up for an hour's service. Notice is given when the movement ceases by a small bell, which is struck by a little ball suspended from a wheel, which, in turn, revolves, for the purpose of keeping the bell and the ball separate.

By the way, we remark, that a recent protection for patent has been allowed (No. 2898) to a Liverpool applicant, for "a method of roasting meat, poultry, and game, by basting the same."

THE DECIMAL COINAGE COMMISSION is still sitting; a report, however, of their proceedings, up to the present time (April), has been published, including a series of resolutions drawn up by Lord Overstone, condemnatory of the decimal system of coinage altogether. He considers that the number 12 presents greater advantages than 10, and that a coinage founded on the first number is more convenient for the purposes of the shop and market. These resolutions are still under discussion, and a report will shortly be prepared by Lord Monteagle, the President of the Commission.

THE COMBINATION OF WORKMEN BILL was (8th April ult.) passed in the Commons.

THE SOUTHERN HIGH-LEVEL SEWER [upwards of 9 miles in length] of the Great Metropolitan Drainage, is announced for tenders (open till the 19th May instant).

THE FORMER "MAIN DRAINAGE COMMITTEE" of the Metropolitan Board of Works, and consisting of twelve members, is now, by a recent resolution of the general body, merged in the committee of the whole Board.

AN ACCIDENT TO THE "BRAY'S TRACTION ENGINE" occurred, 9th April ult., in Nelson Street, Greenwich, owing to the sudden embedment in the roadway of the wheels of this ponderous machine, itself 5 tons in weight, and laden with a main-shaft, weighing 22 tons 8 cwt., proceeding from Penn's Factory to the *Howe*, lying in Woolwich Dockyard. The engine was steaming up the road at about 3 miles an hour, when, in order to avoid some newly-put down macadamised stones, it was turned towards the kerb; but that part of the road being over some cellars, suddenly gave way, and it required the efforts of a number of labouring men, aided by powerful jacks, iron levers and plates, with enormous steam-power to extricate the engine, and raise the immense weight upon the sound earth; an operation which was accomplished without further accident after little over an hour's delay, and consequent interruption of the roadway traffic.

GUNPOWDER MILLS.—The last few weeks has been unprecedently prolific in disasters to powder factories, three instances of explosion, all of them as yet totally unaccounted for, having occurred in rapid succession. Whether the increasing liability to accidents of this destructive character be attributable to defects in the machinery employed, to negligence in management, or, to another cause, which hitherto appears to have been altogether overlooked—namely, to imperfect knowledge of the chemical properties of the new ingredients which, as we have some reason to believe, are now being (*experimentally!*) employed in the hope of producing an "improved" kind of gunpowder—is a question as yet undecided; the subject is of so momentous a nature as to call for the strictest scientific, and, if need be, legislative investigation. Subjoined are the casualties to which we allude:—

I. AT THE HOUNSLOW GUNPOWDER MILLS (Messrs. Curtis and Harvey) a tremendous explosion, attended with the loss of six lives, occurred in the lower press-house on the morning of the 30th March ult. Inquiry as to cause of disaster still pending.

* Some former attempts, by other inventors, a few years since, in the same direction, are understood to have failed from the complexity of the principle on which they were constructed; an objection, however, which we hear, does not attach to the present machine, which is described as being extremely simple.

2. At the Faversham Gunpowder Mills, near Are (Messrs. Hall and Son), on Sunday morning, 2nd April ult. Explosion, causing great damage and alarm, but fortunately unattended with loss of life. Cause unexplained.
3. At the Battle Gunpowder Mills, about 6 miles from Hastings, Sussex (Messrs. Lawrence and Son). Explosion in a corning-house, 13th April ult. One man killed. Building (connected with the Lower Pepperenye Works) shattered for several hundred feet. Vast blocks of the masonry, &c., thrown to a distance of 200 ft. Cause unexplained.

Paper from Textile Plants from Algeria.—A recent Imperial decree authorises the importation into France, duty free, of paper-pulp manufactured in Algeria from various textile productions of that country, chiefly the *sparte* or *alpha*, the *diss*, and the leaf of the *palmier-nain*, or dwarf palm, all of them growing wild and without culture on vast extents of soil, and which are gathered by the native population, who bring them to the manufacturing depôts, or to the shipping-ports. This new branch of industry is due to M. Riffard, who, in conjunction with the Messrs. Hennecart, the proprietors of the paper mills at Ectarcon, in the Department of the Seine-at-Oise, by their new (patented) process, are able to convert, in less than twenty-four hours, the raw *sparte*, from Algeria, into paper of excellent quality, very white and strong, and at so low a price as to compete successfully with the usual kinds of paper from cotton, rags, &c., the pulp obtained from the *sparte*, or from the dwarf-palm, may be mixed advantageously, as regards price of material, with the usual pulps, or may be used pure, in the production of papers of a superior kind. Algeria, it has been practically estimated, can furnish annually, upwards of 100 millions of kilogrammes of raw textile material, equivalent to about 70 millions of kilogrammes of the manufactured pulp, capable of being converted into the best kinds of paper.

Artificial Wood for Ornamental Work, &c.—Recently, at the Conservatoire des Arts et Métiers, M. Payen described the process of manufacturing a kind of ebony, or artificial wood, very hard, very heavy, and susceptible of receiving a high polish, and a brilliant surface with varnish. M. Ladry, the inventor of the process, takes extremely fine wood sawdust, mixes it with blood obtained from the slaughter-houses, and submits the pasty substance thus formed to the action of a powerful hydraulic press. By using strong hollow moulds, articles of any required shape may be produced, having all the appearance of ebony, exquisitely carved by hand. Another curious application of the process consists in the manufacture of brushes; the horsehair is first inserted in the still soft paste, the paste is covered with a plate pierced with holes which leave a passage for the tufts of horsehair to pass through; pressure is then applied, and brushes in one single piece are obtained far more durable than on the old method, and much cheaper. M. Ladry's artificial wood is much heavier than any other kind of wood hitherto in use.

Phonautography.—Under this designation, a new and singular discovery is announced, by means of which *sounds* may be made to record themselves, whether these sounds are those of musical instruments, or emitted by the voice in singing or speaking. The mark produced on paper by a particular note is invariably the same: so also, if a person speaks, the tone of voice in which he speaks is faithfully recorded. The inventor appears sanguine in his hope, by improved apparatus, of being able to print a speech, which may be written off verbatim.

The Glass-trade Strike, or "lock-out," which commenced twenty-five weeks ago, has been satisfactorily terminated by mutual agreement of workmen and employers; it will take at least three weeks more before all will again be ready for commencing work.

RAILWAYS, &c.

The [Proposed] Metropolitan Railway has obtained the support of the Common Council, who, at their adjourned meeting (1st April ult.), agreed to the Report of the Improvement Committee, recommending the Corporation to take a direct interest in the proposed railway, to the extent of 20,000 shares, amounting to £200,000, subject to certain conditions and guarantees.

Lowestoft to London, and Yarmouth to London—distance reduced.—By the agreement recently arranged by the Norfolk Railway Company with the East Suffolk, Eastern Counties, and Norfolk and Eastern Union Companies, for the use and working of the East Suffolk Line, the distance from Lowestoft to London will be reduced from 150 to 116 miles; and the distance from Yarmouth to London from 145 to 121 miles.

The New "Stratagetic" Railway.—The junction line from Woolwich Arsenal to the main South-Eastern Line, recently commenced under contract with the War-department (see our last Month's "Notes and Novelties"), for the speedy transport of guns and war-stores to the coast-stations, is in rapid progress. Embankments have been levelled, buildings razed, and bridges commenced, so as to make the transit available with the greatest possible expedition.

The [Proposed] London Bridge and Charing Cross Railway, after a careful and lengthened inquiry before the Committee of the House of Commons, has been approved of—the Committe having (4th April ult.) decided that the preamble to the Bill had been proved, subject to a definite arrangement to be inserted as to the compensation to be paid by the Company to the Governors of St. Thomas's Hospital, part of the site of which is required for the London Bridge Terminus of the new line.

Spanish Lines—Reuss to Mont Blanch.—The "Gazetta de los Caminos de Hierro" announces, that the project of continuing this line to Lerida and the port of Taragone having met with the entire approbation of the Municipality of Lerida, the works for effecting this object are being advanced with all expedition.

On the Seville and Cordova Railway, the inauguration of the section as far as Lora del Rio took place, to the delight of the whole population, on the 5th of March last. The first train held 759 passengers.

The Northern [Spanish] Railway continues to advance rapidly. The earthworks between Valladolid and Arevalo are all but terminated. The Medina and Duero bridges finished: those of Arévalo, Gomeznano, Valdestillas, and Viana, nearly keyed in. Preparations are already making for the working of the line, forming staff, &c.

The Madrid and Jadraque Railway, on the line to Saragossa, advances satisfactorily. The ironwork for bridges, &c., has been contracted for.

Italian Lines.—Rome to Civita Vecchia, all but finished. The other portion, from Rome to the Adriatic and to the River Pô, in a very forward state. Mr. Brian, who constructs the line from Ancona to the Pô, is also the contractor on the Ancona and Bologna line for the permanent way and ballasting.

Roman Lines.—The Company of the "Pio Centrale" Railway are in full activity. They announce in the "Giornale Delle Strade Ferrate," for tenders to supply sleepers, &c., for the line from Rome to the Adriatic, 280 kilometres, divided into four parts of equal length. Also for the portion from thence to join the Pô. This latter, 258 kilometres in length, is to be divided into three portions.

Franco-Swiss Line.—In the Canton of Neufchâtel the works are progressing rapidly. They are so far advanced as to justify the expectation that direct communication between Geneva and Bâle will be open in July next.

The Junction of the Lombard and [Sardinian] Victor Emmanuel Lines is in progress. Several Sardinian engineers, amongst them M. Bonelli, have been present at a conference in Milan, relative to the "International Station" of the Tessino, having for its object the junction of the above lines.

Switzerland—Lausanne to Fribourg and the Bern Frontier.—This line, recommended by the Council of State, is 85 kilometres in extent. Earthworks, &c., already contracted for, 41 kilometres, 850 m. Estimated cost, 9,320,000 fr., but adding expenses of rails, metals, &c., 525,000 fr. per kilometre, exclusive of sheds and stations. Original estimate, 300,000 fr. per kilometre. Excess over estimate accounted for by unusually expensive nature of some of the works, such as the viaduct of the Sarine to Fribourg; the three viaducts of La Paudèce, the Lutrive, and the Châtelard; and those of the Guin and the Singine, &c.; moreover, there are five tunnels to be driven on the line, altogether 2,400 metres in length.

Troops on Railways.—Recent experiments, made on the Kœnigsberg Railway, for the conveyance of a squadron of cuirassiers, have shown that an entire squadron could be conveyed in one train; from six to nine horses, carrying baggage, with the men required to watch over them, being placed in each horse-waggon, and the soldiers in third-class carriages. Experiments were also made with a sort of Iron Bridge, for enabling the horses and men to descend from the train where there are no platforms. It was found to answer perfectly.

The Cornwall Railway is positively announced for opening for traffic on the 2nd May instant. To more fully test the Royal Albert bridge, and the other bridges to Saltash, two engines, with sixteen trucks laden with coals, with an aggregate weight of above 300 tons, passed over them (under superintendence of the Government Inspector for the Board of Trade) with perfectly satisfactory result.

The Railway Traffic Returns for the United Kingdom, for the week ending 16th April, 1859, amount to £444,290; showing an increase of £23,510 over corresponding period of last year. Gross Receipts on the eight railways having their termini in the metropolis, amounted, for same week, to £184,281; increase over corresponding week in 1858, £3,665.

Australian Lines.—Melbourne to Sandhurst.—First portion of the main line opened for traffic on 13th January ult. in form by the Governor, accompanied by the Members of Parliament and the City Corporation. The line to Williamstown, ditto.

East Indian Lines.—The Punjab, Lahore, and Umritzir.—Works proceeding by native contractors; and pending arrival of steamers, contracts had been entered into for conveyance of materials from Kurachee to Umritzir and Lahore, by native boats.

The Bombay, Baroda, and Central India Railway Bill passed the Lords 15th April ult.

Indian Lines.—Southern of India.—The first section of the railway between Negapatam and Trichinopoly, a distance of 80 miles, is to be forthwith commenced, with a guaranteed interest of 5 per cent. per annum on £1,000,000, the estimate of the Court of Directors of the cost of the undertaking. The surveys are being made, under Mr. Thompson Maclagan, of Madras, agent for the Company in India, and Mr. Mark W. Carr, engineer-in-chief. Works to be executed by Company's own officers, &c., instead of by contractors, as being most economical. Contract made for stores, service, materials, rails, chairs, and fastenings for first fifty miles of permanent way. This line will pass through the heart of Tanjore, "the Garden of India," containing a population of 2,000,000; and through the district of Trichinopoly. Chief stations at Negapatam, a seaport on the western coast of the Bay of Bengal, the town of Tanjore, ditto of Trichinopoly. Traffic estimate:—100,000 tons of produce and manufactured goods, chiefly rice, silk, muslins, and cotton, are annually conveyed through Tanjore to Negapatam for exportation: also the chief source of supply to Madras and Southern India.

The Ottoman Railway undertaking appears to be proceeding rapidly, the contractor pushing forward the works. Only 9,250 out of the 60,000 shares remain unappropriated.

The Honduras Interoceanic Railway.—From the maps of the line and ports, prepared by Lieut.-Col. Stanton, R.E., the officer deputed by Government to review this [intended] route, it appears that this is the most direct line between this country and Australia; that the harbours, both on the Atlantic and Pacific, are spacious, accessible, and safe in all weathers; that the Bay of Fonseca is upwards of 3,000 miles nearer to Vancouver's Island than Valparaiso, and 700 miles nearer than Panama to British Columbia. A substantial contractor has tendered to construct this railway for £2,500,000. It will bring Great Britain within 18 days of the Pacific Coast, and within about 40 days of Australia.

At Cape of Good Hope—Wellington to Cape Town Railway—(late advices to February 21) engineers were staking out this line.

Accidents on Railways.—Walking on the Line.—A fatal accident occurred recently on the Midland Railway [of Ireland], between Athlone and Ballinasloe. A plate-layer and his wife were walking on the line, when the down mail train overtook them, and they were killed on the spot. Verdict—"Accidental Death," with no blame attached to the Company.

Cattle on the Line.—Recently, as the goods train of the Western Railway, from Caen, was approaching the Mesnil-Mauger station, it came into collision with a drove of 16 oxen, which had strayed on to the line, and killed 3, seriously injuring 4. By the collision four trucks were thrown off the rails, and they ran some distance before they were stopped.

Crossing Lines.—A fatal accident occurred (1st April ult.) at the Wallington station, Leeds, to a person who was passing from the platform on to the line at the moment the 9.40 North-Eastern train was setting back to the platform. The train passed over his head, crushing it to atoms, and also severing one arm from the body. Verdict—"Accidental Death."

Another Fatal Accident occurred recently on the Great Northern railway, at Shaftholme Gate-house, where a farmer, standing between the down rails whilst the Edinburgh express train passed, and not noticing the approach of the Doncaster down train, was run down by the engine and killed on the spot. The driver had seen him, and whistled, but without avail, and before the break could be applied the engine was upon him; his body became entangled with the wheels, by which it was carried about 20 yards, and then dropped.

Fatal Collision with a Railway Signal Post.—A frightful accident occurred as the (evening) special train to Hexham was (4th April ult.) passing the Manor station, at Newcastle. A young man was inacutiously leaning out of a carriage window as the train was flying past the station, waving adieu to his friends, when his head came in contact with the signal post. He was dragged out of the carriage by the violence of the collision, and thrown upon the platform a mangled corpse.

On the Eastern Counties Railway (Sunday evening. 3rd April ult.), near the Mile-end station, Cambridge Heath-road, an intending passenger hearing the approach of a train, ran up the staircase to the platform connected with the up-line. The train was going to Bishopsgate-street, when he, by some means, fell forward on to the line. The engine-driver speedily stopped the train, but not until the wheels of the carriages had passed over the unfortunate man's body, so frightfully injuring him that he expired on the 4th of April ult., in the accident-ward of the London Hospital, whither he had been removed. Verdict, "Accidental Death."

The Recent Chasm Accident to a Train in Canada.—On the line of the Great Western [of Canada] railway, 19th March ult., a fearful, if not unprecedented, calamity occurred about a mile west of Dundas, attended with the loss of seven lives, and serious injury to many others. At the point where the casualty occurred, the track crosses a deep ravine, which had been filled in, so that it was thought that a solid embankment had been made which nothing could disturb. The water, however, accruing from the late heavy rains, had apparently made a passage-way through the bottom of the embankment, and a yawning chasm of about 100 yards in length and from 40 to 50 ft. deep had been rapidly made. When the night express-train arrived at this point, it was dark, and no sign was afforded of the awfully dangerous pitfall to which the train was hurrying on its way. In an instant, the engine and train leaped into the hole, closely followed by the baggage-car, an emigrant-car, two first-class passenger-cars, and a "sleeping-car." The result was that seven persons were killed on the spot, including the locomotive-superintendent, engineer, fireman, and breaksman, and a great number of the passengers (chiefly those in the second first-class passenger-car, which was a complete wreck), grievously injured.

A South-Western Railway Guard fell off his break at Barnes-bridge, and was so injured that, a few days afterwards, he died in St. Thomas's Hospital, on the 7th April ult. Verdict, "Accidental Death."

Railway Official Dangers in India.—By recent accounts [from Bombay], we learn that, in the Banda and Jalour Districts, one of the rebel chiefs, Husment Sing, Sirdar of Rewar, succeeded, on the 25th of February last, in surprising and murdering Mr. Evans, Chief Engineer, and Mr. Limnell, District Engineer of the Jubbulpore and Allahabad Railway.

On the Pernambuco Railway [recent advices from Brazil and River Plate] a very serious step has been taken by the engineer of the line.—On the 21st February last, he took forcible possession of the works.

The Tramway [in Ireland] Bill (30th March ult.) went into Committee of the House of Commons, and, after some amendments negativing clause 40, prov iding for the "seizure or detention of persons trespassing on the tramway," and addition of a clause to facilitate the conveyance of Government troops, militia, constabulary force, stores, &c., by any Tramway Company, was reported. On the 7th of April ult., read a third time, and passed.

The Great Northern and Western [of Ireland] Bill, was (8th April ult.) read a third time, and passed, in the Lords.

The Oporto Railway (New) Contract with Sir Morton Peto (Signor S. Pimentel, Minister of Public Works), has been put to the vote in the Portuguese Cortes and rejected. If, therefore, Sir Morton should decline to act under his former contract, for which a fixed time has been given him by the Cortes, there will, in all probability, for the present, at least, be no railways in Portugal.

The Copiapo Railway Company held its first general meeting (London, 5th April ult.) Line completed, and now in operation. Engineer's report favourable. Total outlay £174,867.

Great Western [of Canada].—Toronto advices announce, that the inquest into the cause of the late accident on this line, near Dundas, resulted in a verdict exonerating the company from all blame.

The Grand Trunk Railway Line [of Canada] according to the recent circular statement of the Directors, has cost, equipped with working-stock, and including the Victoria Bridge, about £10,000 per mile. The length of line now open is 880 miles. The total estimated cost of the line was £9,500,000. Actual capital raised and expended, to this date, £8,426,000; and £1,111,500 is about to be asked for further, at a meeting of the shareholders in Canada. This sum will suffice to open the whole line, from Sarnia to Quebec, and Riviere du Loup, and to Portland, a total length of 1,057 miles, including the Victoria Bridge.

Laden Trucks.—On the Newport, Abergavenny and Hereford Railway (15th April ult.) a driver was in charge of an engine to which were attached trucks laden with iron-rails. Disregarding the caution-board erected at "the summit," $2\frac{1}{2}$ miles from Pontypool Road, directing drivers of goods-trains to stop there and apply their breaks to each truck, he went over the "summit" without stopping; the train, by the impetus gained, rolled on with fearful rapidity, and became uncontrolable; at last the engine ran off the line, and tumbled over, smashing a number of trucks, and bending up the iron-rails like willow wands. Traffic stopped for several hours; but no one hurt. The engine-driver absconded; but a warrant has been issued for his apprehension.

On the Railway from Munich to Augsburg, a few days since, the train, with the King of Bavaria in it, on his road to Darmstadt, went off the rails near Olching. No serious result.

The Relative Speed of Trains, in a given time, of different countries, has been calculated as follows :—

	Main-Speed.	Express.	Maximum.
England	36	60	82
Germany	36	58	76
United States	40	86	100
France	40	72	86

A Railway Train on Fire.—The 8·20 Express Train for Liverpool, shortly after leaving Warrington, was discovered (by the passengers) to be on fire; the roofs of two of the carriages next to the engine, and all the luggage, were in a fierce flame; but, in the absence of any means of communication with the guard, &c., the engine still hurried on: ultimately, however, alarmed by the loud cries of the passengers and the brilliant light, the driver brought his engine to a stand in time to enable the passengers to escape unhurt. The flaming carriages were then detached, and the train proceeded on its journey.

TELEGRAPH ENGINEERING, &c.

Telegraph Communication between Holyhead and the Liverpool Docks is about to be established: the Liverpool and Mersey Dock and Harbour Board having recently concluded with Messrs. Glass, Elliot and Co. a contract for the construction of a submarine cable in connection with the intended telegraph between Liverpool and Holyhead station. A line of telegraph wires is, also, to pass along the entire length of the Liverpool Docks: the wires will pass through the principal warehouses of the Dock Trust; and will be of great service in the event of fire, &c. occurring to the shipping in the docks.

The Indian Telegraph System is receiving a rapid extension. From Bombay, a coast-line of telegraph is in course of construction to Goa, where it will join the projected line *viâ* Cochin to Cape Comorin, so that there will be an independent coast-line from Calcutta to Bombay *viâ* Madras and Manaar. Bombay will also communicate with Surat, directly, instead of sending round by Nassick; and from Surat, the line already completed to Kurrachee, will be pushed on towards Lahore, which will thus be placed in telegraphic communication with Bombay. When the line to Napore from Bombay is finished, Calcutta and Bombay will be able to communicate by three routes—one *viâ* Madras, another *viâ* Napore and Benares, a third *viâ* Agra.

The Atlantic Telegraph Company Bill (No. 2) was ordered for third reading in the Commons, 5th April ult. 8th April ult. read a third time and passed. On the 14th April ult. read a third time in the Lords, and passed, the Standing Orders being suspended on this occasion.

Marseilles to Ajaccio.—The French Emperor has (4th April ult.) granted a concession of this cable to Mr. Bingham (a pupil of Professor Faraday), a resident in Paris. Owing to frequent mishaps in the Mediterranean lines of submarine telegraph, the Emperor summoned that gentleman to an interview, in which he personally investigated Mr. Bingham's improved system; hence the above concession.

The Indian and Australian Telegraph Company (No. 2) Bill passed through Committee in the Commons, 5th April ult.

The Red Sea Line, as regards at least its preliminary steps, is proceeding satisfactorily. Advices from Aden (to 19th March ult.) stating that the trip of the *Cyclops* along the South-East Coast of Arabia has been so far successful that the Vakeel at Maculla had willingly assented to the landing, at a spot selected near that town, of the submarine-wire; and, indeed, to the erection of a telegraph station wherever the English might think fit, within his territory. At the Kooria Mooria Islands the same favourable result has attended Captain Pullen's survey; and Hallania is the island selected for a station—a safe spot in the little harbour being fixed upon for the landing of the cable. On account of certain local difficulties, it is probable that the cable will be taken direct from Hallania to Kurrachee, but buoying at the outset off Ras-el-Had, in order that some third station may be selected should the distance prove too long. At Kurrachee the cable is to be brought in, east of the Lighthouse, and must be laid several miles overland to reach the town. The Soundings, as obtained by Captain Pullen, were:—from Aden to Maculla, from 20 to 742 fathoms; from Maculla to Kooria Mooria, from 100 to 1,150 fathoms; from Kooria Mooria to Ras-el-Had, from 21 to 897 fathoms; from Ras-el-Had to Kurrachee, from 21 to 2,020 fathoms. Except between Hallania and Ras-el-Had, where it is rocky, the entire bottom consists of mud and sand; and probable reason to anticipate, that the sea-bed offering no really great irregularities, nothing more formidable than undulations will obstruct the successful submergence of the cable throughout the line. Before the setting-in of the south-west monsoon, the *Cyclops*, at present refitting at Bombay, will be back again at Aden, to accompany the *Imperador* and *Imperatrix*, and superintend the laying of the cable between Suez and Aden.

A [Canadian] "Transatlantic Telegraphic Company" is on foot: late advices from Toronto, C.W., announcing that a Bill has been introduced for incorporating an enterprise including a line to Quebec *viâ* Labrador, capital £1,000,000, augmentable to £5,000,000; to be commenced within one year, and completed to Labrador within three.

Lines of Submarine Telegraph which have been laid up to the end of 1858 :—

Dates when laid.		Distance in miles.
1850	England and France	$22\frac{1}{4}$
1852	England and Belgium	$79\frac{3}{4}$
,,	England and Ireland	64
1853	England and Holland	$107\frac{1}{2}$
,,	Ireland and Scotland	$24\frac{3}{4}$
1854	Italy and Corsica	64
,,	Corsica and Sardinia	$9\frac{1}{4}$
,,	Denmark (Great Belt)	$14\frac{1}{4}$
,,	Denmark (Little Belt)	$4\frac{3}{4}$
1855	Denmark (Channel of the Sound)	$11\frac{1}{8}$
,,	Scotland (Frith of Forth)	$3\frac{1}{2}$
,,	Black Sea	$371\frac{1}{4}$
,,	Solent (Isle of Wight)	3
1856	Straits of Messina	$4\frac{3}{4}$
,,	Gulf of St. Lawrence	74
,,	Strait of Northumberland	$9\frac{1}{4}$
,,	The Bosphorus	$1\frac{1}{8}$
,,	Nova Scotia (Isthums of Canso)	$1\frac{3}{4}$
,,	St. Petersburg and Cronstadt	8
1857	Sicily and Algeria	$149\frac{1}{2}$
1858	Bay of Valentia (Ireland) and that of Trinity (America)	$1,827\frac{1}{4}$
	Total, in 1858	$2,771\frac{1}{4}$

Isle of Man and the Main Land.—An electric cable is to be laid down from St. Bees ("the Heads"), as being the nearest point on the coast to the Manx shores. A branch-telegraph is also in contemplation from the lighthouse on St. Bees Heads to the main-line, as likely to be of great advantage to the shipping interest.

The Candia and Alexandria Submarine Cable (advices from Trieste, 21st April ult.) is to be laid down on the 1st May instant.

The Submarine Telegraph Company have announced a general reduction of charges to the Continent, dating from the 1st April ult.

The Red Sea and Indian Telegraph Company Bill (No. 2), after an apparently unopposed progress through Parliament, has been postponed. In the Lords (15th April ult.) the third reading of the Bill was adjourned, Lord Stanley of Alderley objecting to various clauses in it, more especially to the guarantee clause ($4\frac{1}{2}$ per cent., not, as the Earl of Derby explained, on the £800,000 capital, but on the sum actually spent in laying down the telegraph), and other provisions, which he designated as "monstrous."

Malta and Cagliari.—The Mediterranean Extension Telegraph Company are ("Sun," 11th April) about to send a steamer to the Mediterranean, to commence the repairs of this cable.

MARINE STEAM ENGINEERING, SHIPBUILDING, &c.

The Institution "Self-righting" Life Boats have recently become the subject of serious controversy amongst nautical men. The beachmen in a body having expressed an opinion adverse to the principle of construction and sea-braving qualities of the life-boats recently stationed at Yarmouth, by the Life-boat Institution, Capt. Ward, R.N., the Society's inspector has published a letter in reply to these objections, in which letter he states that "if the new boat is proved, after sufficient trial, to be unsafe or unsuitable [for service on the Norfolk coast] she will not be forced on the locality." Capt. Spencer Smyth, R.N., backs up the views expressed by the [95] Yarmouth beachmen, who have declared their intention not to use the new boats, as he (Capt. Smyth) thinks them "unsafe, and ill-calculated for service on that coast." Here, for the present, the matter rests.

A Life Boat for the Lake of Geneva has been constructed by the Messrs. Forrest, of Limehouse, the inhabitants of the city of Geneva having decided to station one of the Institution's life-boats on their lake, and for that purpose given directions to have a small single-banked boat on the Institution plan built in this country. A harbour-trial of her qualities took place (2nd April ult.) in a canal near Regent's Dock, Limehouse; her self-righting and water self-ejecting powers were satisfactorily exhibited.

The Ramsgate Harbour Life Boat [the "Northumberland Prize Life Boat, 36 ft. long] was, in 1852, purchased by the Royal Harbour Commissioners, and presented to Ramsgate, whose vicinity to the wellknown Goodwin Sands, from the north end of which it is distant only 6 miles, rendered this spot peculiarly appropriate to a life-boat station. She has since then, in conjunction with the harbour steam tug, been of the greatest service in rescuing scores of shipwrecked sailors, and saving many a noble ship.

The Merchant Shipping of Belgium, on the 31st December, 1858, amounted to 145 vessels, measuring 44,050 tons; including 7 steamers, together of 5,771 tons. Four of the sailing vessels were upwards of 1,000 tons; 19 between 500 and 1,000 tons; and 110 between 100 and 500 tons: 83 are of Belgian build.

The "Doris" Screw, 32, went (24th March ult.), from Hamoaze, outside Plymouth Sound, to try her engines.

The "Cornet" Paddlewheel, has gone into No. 2 dock, Devonport, for repairs.

For the Indus Steam Flotilla [late advices], the contract with the Indian Government has been completed.

Steam *v.* Slave-trade.—Her Majesty's steamship *Triton* entered St. Helena, 27th February ult., in charge of a Brigantine, captured off Killongu, on the west coast of Africa, lat 4 deg. 32 min. S., long. 10 deg. 52 min. E. The *Triton* was at anchor when the Brigantine was first discovered standing in shore; she altered her course immediately, and stood to sea. The *Triton* got up steam, and, *chasing all night*, came up with her at 7 a.m. She was fully equipped for the slave trade, exhibited no colours, and produced no papers.

The Steamer "North," bound from Hull to Gottenburg, was stranded (at Thisted) at night, on the 28th March ult.

The "Icarus" Screw Steam-Sloop, steamed down the river from Woolwich, 29th March ult., on trial of her engines of 150 H.P., newly fitted. Result of trial satisfactory.

The "Sutlej," (50) Sailing-Frigate, in No. 9 dock, Portsmouth, is being converted into a screw steam-frigate: she will be cut in two, and lengthened 46 ft. 6 in. amidships, 13 ft. 9 in. forward, and 13 ft. 4 in. aft. This will give her, when finished, a length of nearly 260 ft.

The New Slip, constructed of Corrugated Iron, at the east end of Woolwich dockyard, is in readiness for laying down the screw-steamer *Bristol*.

The "Czar" Steamer [Wreck].—Since our last notice, the three salvage-cutters, at the Lizard, have further succeeded in recovering about 100 pieces of machinery, a quantity of new copper-sheathing, and portions of the vessel, as also a quantity of heavy shot, shell, percussion-caps, and other ordnance stores; which latter have been placed in custody of the barrack-master at Pendennis, as belonging to the Government.

The "European and American" Steam Company, has been (5th April ult.), wound up by an order of the Court of Bankruptcy.

The "Severn" 50 Gun Sailing-Frigate, in dock at Chatham for conversion into a screw-steamer, is ordered to be cut asunder, and lengthened 50 ft. amidship, 18 ft. aft, and 23 ft. forward. With these alterations, this vessel, it is asserted, will be one of the finest frigates belonging to the British navy.

The "Forte" New Steam-Frigate, 51 guns, of 400 H.P. (nominal) left Sheerness on the 5th April ult., for a final trial of her engines. In six times running the measured mile in the Swin, she averaged 11½ knots: she made from 58 to 60 revolutions, with a vacuum of 25 lb. and 20 steam-pressure. After running for a trial of speed, she proceeded towards Harwich, and returned to her moorings. The Admiralty and engineer authorities expressed themselves highly satisfied with the working of the engines.

The "James Watt" Screw Steam-ship, (91), is under repair at Keyham: it has been found necessary to take out her boilers. On the 15th April ult., steam was got up on board to test boilers.

The Aggregate Tonnage of all Ships built in our National dockyards, including those converted into screw-ships on the slip, between April 1848 and April 1849, is 209,408: and the cost £4,948,378; of sailing-ships converted into screw-ships in dock, aggregate tonnage of 54,700, cost of process £323,118.

The Launch of the "Hood" Steam-ship, 91 guns, line-of-battle screw, is fixed at Chatham dockyard for the 4th May inst. She is afterwards to be taken to Sheerness, to be fitted with 600 H.P engines.

Steamer Launches.—Recently, from the building-yard of Mr. Denny, Paisley, a paddle-steamer of small tonnage, but beautiful model, intended to ply on Lochyoil. Immediately on being launched, her boiler was put in, and she was towed through the bridge to the Leven Engine Works to be fitted.

The "Revenge," screw steam-ship-of-the-line, pierced for 91 guns (considered a good specimen of the new class of 91's), is ordered to be launched at Pembroke Dockyard. Her dimensions are:—Length between perpendiculars, 234 ft. 3 ins.; length of keel for tonnage, 199 ft. 1⅝ in.; extreme breadth, 55 ft. 4 in.; depth of hold, 24 ft. 5 in.; burden in tons, 3146 1-3rd.

The "Salsette"—the First Australian Mail Steamer, under the new contract, arrived at Suez only one day after time. This is considered satisfactory, inasmuch as, owing to the Peninsular and Oriental Company's Coal Depot in Australia not yet being supplied with English Coals, the *Salsette* had to cross the Indian Ocean with Australian coal, which is an inferior description of fuel.

The Steam Factory Department at Sheerness Dockyard is all bustling activity, to provide machinery for the screw and paddle-wheel steam-vessels being there prepared for commission. The contractors (Messrs. Maudslay, Field, and Co.) have also received hastening orders to complete the setting up of the engines and machinery fitting by them, in consequence of which an increase has been made to the staff; and extra hours are being worked to complete every thing by the time specified by the Admiralty.

The "Doris" Screw Steam-frigate is to make a series of trials of Griffiths's screw at various pitches, and also of the common screw, considerably modified and altered in various ways.

Cast-iron Sleepers.—The "Cheerful" (2) Screw Steam Gunboat, hauled up, a short time since, on the gunboat slipway at Haslar, to have her boilers lifted and replaced on cast-iron sleepers, in the same manner as all the gunboats are fitted that are now in the sheds at Haslar, was (14th April ult.) launched off the slipway with her steam up, under superintendence of the Inspector of Machinery Afloat, and immediately she reached the water she steamed away to her barbour moorings. All the gunboats lying up the harbour are ordered to have their boilers lifted, and fitted with cast-iron sleepers on this plan.

Steamer Collisions.—The *Bruiser*, General Steam Navigation Company's steam-vessel, from London, proceeding up the Tyne (7th April ult.), ran foul of the *Britannia* steamer, for Leith, striking her bow with such force that the *Britannia's* fore compartment speedily began to fill with water, and she gradually settled down. Passengers and crew saved. The *Bruiser* sustained but trifling injury, and proceeded to Newcastle Quay. Attempts are being made to raise the *Britannia*.

The "Perseverance" Screw Steam Troopship (2) recently ran down the bark *Ava*, off the Lizard; and was (11th April ult.) towed from Hamoaze to Devonport, where the stump of her bowsprit was removed. 14th April, supplied with new figure-head and bowsprit, and ordered for Cape of Good Hope.

Steamers Lost.—The "Preston," from Bordeaux to Liverpool, in making her way up the St. George's Channel for the Mersey, struck on a reef a few miles to the eastward of the South Stock. She rapidly filled, her hull having been rent open by her working on the reef. In about half an hour her funnel and masts went—the vessel broke in two, and for miles the beach was strewed with her cargo, the value of which was considerable.

The "General Williams," on her voyage (3rd April ult.) from London, to the Piræus of Athens, Smyrna, and Constantinople, laden with iron, through stress of weather, foundered stern-foremost (struck by a heavy sea in lat. 36·10 N. long 18, 20 E., 200 miles from Malta), having 14 ft. water in her hold, and higher than donkey-engine in her engine-room. Crew (42 in number) saved by the French brig, *Augustin Elize*, and landed at Malta. This steamer was iron-built, and had a tubular mizenmast of some metal.

The "Jaseur" British Steam Gunboat, of 800 H.P., numbered 642 on the Royal Navy List, and last stationed in the West Indies, struck (on the night of the 26th March ult.) upon the Riscondor reefs, whilst on her way from Port Royal to Grey Town, and became a complete wreck. Her crew (60 in number) escaped in boats and rafts; three (subsequently) perished.

The Rangoon Mail Steamer *Cape of Good Hope*, according to telegram from Calcutta, dated March 24, was totally wrecked in the Hoogly, the day preceding, caused by collision with the *Nemesis*. Mail saved.

The "Edgar," New Screw Line-of-battle-ship, 91 guns, in the fitting-basin at Sheerness, has completed the setting up of her engines, so as to be ready for a trial of her machinery.

The "Pioneer" screw steam despatch vessel went out of Portsmouth Harbour, 15th April ult., to try her machinery. Trial satisfactory.

H. M Steamer "Vixen" is at Panama, almost disabled. After-sponson beam broken, and otherwise defective. Hull rotten in several places, near the water-line. Stern fallen 3 in.; and vessel, in fact, altogether (according to last advices, dated Panama, March 25th) unfit to face anything of a breeze.

The Launch of the large Line-of-Battle Screw-Steamer "Hood," 91 guns, will take place at Chatham on the 4th May, at ½ past 1 in the afternoon.

Steamers on the Ganges and Godavery.—The Oriental Inland Steam Navigation Company notify that their operations will, forthwith, be extended to the Ganges, and to the Godavery as soon as the impediments in the bed of that river shall have been removed by the Government.

The Spanish Screw-Steamer, "San Servando," in making for Algeria, on the night of the 6th April ult., went ashore on the rocks in the neighbourhood of the Green Island; but was got off, with assistance, on the afternoon of the 8th, without serious injury.

The "Melponene," now coaling in the Steam Basin at Portsmouth, is having placed on board the whole of her upper-deck guns, and has commenced taking in her main-deck guns. Steam-power is being used for this purpose, in the same manner as formerly applied to the *Mersey*.

MILITARY ENGINEERING, &c.

Piercing Iron-coated Vessels.—Trial was made at Chatham Garrison (25th March ult.) of a new projectile, the invention of Captain Norton, for piercing the sides of vessels coated with iron, and for penetrating the iron plates of floating batteries. The projectile consists of an iron bolt, which may be constructed to any size, according to the calibre of the gun from which it is fired, the length being exactly three times the diameter. The missile is then coated with thin tough paper to about the 16th of an inch in thickness, in order that the impressions of the rifle may not pierce beyond the coating. The gun used was Warry's new breech-loading cannon. On the iron bolt being fired at a stout plank of timber, the missile, in every instance, penetrated the plank, which it struck foremost. It is anticipated that a similar shot, made of tempered steel, will penetrate a plate of forged iron one-half of an inch in thickness.

The Rifled Ordnance Department New Building, in Woolwich Arsenal, was commenced 14th April ult. It will be two stories high, and form one of the most prominent features in the Arsenal. The digging out of the foundation was commenced contiguous to the old Lancaster shell forge, which has been recently organised, and is now in full operation in casting and forging materials to carry out the speedy manufacture of this new branch of the service.

Nortons "Liquid Fire Rifle Shells," when fired from a smooth-bore pistol, have been (recent experiments at Chatham) found to be most effective as destructive missiles. A shell* containing the "liquid fire" was placed in a 10-bore pistol, and fired at a piece of canvas, suspended at the end of a range, to represent the sails of a ship. On the shell striking the canvas the liquid fire was thrown in all directions, and, in less than five seconds, the canvas was on fire. The fire, with some difficulty, was extinguished, and no fire was to be seen; but, in a few minutes afterwards, the canvas again burst out into flame, the liquid fire having penetrated into every part of the substance, proving that the effects of the liquid fire shell are as fearful as they are extraordinary.

Horsefall's Monster 13-inch Wrought-iron Gun, when permanently placed in its position, will form a part of the sea defences of Portsmouth. For the reception of this immense piece of ordnance (midway between Southsea Castle and the Western Auxiliary Battery) a bed of concrete has been made in the shingle, 7 ft. in depth, and on this the gun, with its carriage, platform, and loading crane, will be erected.

Dimensions, &c., of the "Horsfall Monster Wrought-iron Gun:" Length of gun from breech to muzzle, 16 ft. 6 in.; from base-ring to muzzle, 13 ft. 8 in.; base ring: circumference, 11 ft. 4 in.; diameter, 3 ft. 7½ in.; muzzle circumference, 7 ft. 1¼ in.; diameter, 2 ft. 3½ in.; bore diameter, 1 ft. 1 in.; length, 13 ft. 3½ in.; thickness of metal at breech, 1 ft. 10 in.; at vent, 1 ft. 3 in.; at muzzle, 7¼ in. Trunnions circumference, 3 ft. 1⅝ in.; diameter, 1 ft.; length of shoulder, 11¾ in.; distance from centre of trunnions to base-ring, 5 ft. 4½ in.; to muzzle, 8 ft. 3½ in.; circumference of gun round the centre-piece or band, 12 ft. 9 in.; weight of gun, 22 tons; weight of shot, 3 cwt.; service charge of powder, 78 lbs. Carriage and platform manufactured at Woolwich, of teak wood, bolted together in strongest possible manner. Carriage weighs 3 tons 2 cwt. Weight of platform, 4 tons. Gun itself manufactured at works of Messrs. Horsfall and Co., Liverpool, and by them presented to Government. To be so placed as to command the entrance to the channel at Portsmouth Harbour. A single shot from it, taking effect on a ship's hull, would, doubtless, prove decisive of the vessel's fate.

A New "Explosive Fusee" and "Improved Shrapnell Shell."—The invention of Sir William Armstrong, C.B., Government Engineer for Rifled Ordnance, has been successfully tested by a select committee of officers, from Woolwich Arsenal, at Shoeburyness. The shells were fired from a 12-pounder Armstrong gun over a range of 3,000 yards. The mere contact with the surface of the water on which it alighted caused the desired explosion of the shell.

Improved Armament of the Fleet.—The question of adapting the Armstrong gun for naval service is under the consideration of a committee, consisting of Admiral Sir Thomas Hastings, Chairman, Captain Caffin, C.B.. Secretary, Sir John Burgoyne, G.C.B., Inspector-General of Fortifications, and General Sir Howard Douglas. By means of an improved carriage or platform, the gun (as proved by recent experiments) can be so arranged on ship-board as to be fired with the utmost accuracy, and the adoption of the weapon, as an auxiliary to the contemplated improvements in the armament of the fleet, will, in all probability, be recommended by this Committee.

The Prussian "Needle-Musket" [Spitznadel-Gewehr]—that curious invention for firing muskets by the prick of a pin, which has, hitherto, remained a Prussian secret, and with which no other European army is furnished—is now in general use, not only among the [Prussian] infantry of the guards, but in most of the regiments of the line. Its manufacture is at present being carried on with, if possible, increased energy, in the secret recesses of the Royal Arsenal.

The Convoy of 18-pounder Guns, with ammunition, train, &c., &c., which departed (18th April ult.) from Woolwich Garrison, for Colchester and Chichester, comprising four complete siege-batteries, required about 500 horses for its conveyance. Each gun was drawn by twelve horses.

The New "Percussion Cartridge" (Captain Norton's invention), has been experimented upon, to show the ease with which pieces of rock, stumps of trees, and other obstructions in the passage of a body of troops, can by its aid be removed. The stump of a tree having been selected, Captain Norton had a hole bored, about halfway down, across the grain, and near the most knotty part. One of the new percussion cartridges was then inserted in the hole, and rammed down with an iron bar. On the bar being struck with a plank of wood, the cartridge exploded, splitting the tree in a thousand fragments, demonstrating the value of these cartridges for engineering purposes.

Improved Gun Carriages.—The Ordnance Select Committee at Woolwich (Major General Cator, C.B., Royal Artillery, President, assisted by Col. Tulloh, Superintendent of the Royal Carriage Department), is now engaged in directing the construction of various specimens of gun-carriages, which will be tested with a view to the best means of adapting Sir William Armstrong's gun to the requirements of both the military and naval services.

A Serious (alleged) Defect in the Construction of the Enfield Rifle, is causing some controversy amongst practical military men. It is thus stated. In the act of an expansive bullet passing through the tube of a rifle, a considerable degree of expansion or enlargement of size is induced in the outer form, running like a wave, coincident

* The missile consists of a spherical-shaped piece of soft wood, about 6 in. in length, or, generally, a little more than 3 diameters of the bore of the rifle of the cannon used in discharging it. The inflammable compound with which the shell is charged is imbibed by the pores of the wood—that of pine being recommended. In ordinary shells the outside metal takes no part in the conflagration, which it rather retards; whilst, in the improved missile, all is fire, the shell-part itself being incendiary, as well as the charge.

with the bullet's velocity. If, *on any portion* of the barrel, an increase of metal takes place, a rigidity arises, materially interfering with the "wave of expansion." It results, that the rebound produces the opposite fact—namely, "a contraction." This may be easily proved. Place on the barrel of a rifle of weak construction (such as the "Enfield") a ring of iron, fitting mechanically tight, and the strength or substance of which is greater than that of the tube of the barrel; fire it ten or fifteen rounds, with this ring on the barrel. On examination, it will be found that the ring is loose, and a corresponding indentation produced in the barrel; and, on internal measurement, a certain contraction of the bore is perceptible. Now, the bayonet-socket is this ring. The barrel consequently contracts by its yielding in the weakest part—namely, the three grooves, which are now narrowed on the bore top, and hence the defect. Remedy proposed—"better metal, or more of it."

THE ROYAL ENGINEER'S OFFICIAL DEPARTMENT, hitherto situate in one of the west wings of the Royal Artillery Barracks, Woolwich, was, 6th April ult., transferred to the new department erected near the White-gate, in Millwall-lane.

THE "MALLET-MORTAR."—In the House of Commons, 7th April ult., General Peel (in reply to an inquiry on the subject by Lord Palmerston) stated that the expense of the last experiment connected with the trial of this large mortar, had exceeded £18,000! and the last report of the Committee was to the effect that they did not think it advisable to continue any further experiments with the mortar.

THE ARMSTRONG RIFLED ORDNANCE.—The supplemental vote of £30,000 for establishing a factory at Woolwich for the manufacture of this new invention, was, 7th April ult., agreed to in the House of Commons.

FIRING MINES, &c., BY MAGNETISM.—The chemist to the War Department (Mr. F. A. Abel), made (7th April ult.) some further experiments for the purpose of demonstrating the manner in which charges of gunpowder may be fired by means of magnetic agency. The experiments took place at St. Mary's-creek, adjoining the practising-ground of the Royal Engineers, Chatham, where several charges of powder were fired by the new agency employed by Mr Abel, which, it is asserted, is likely to supersede the voltaic battery at present used for submarine and other explosions.

THE PATENT FOR INVENTIONS (MUNITIONS OF WAR) BILL (authorising Secret Patents for improvements in fire-arms, &c., to be granted) received the Royal Assent by Commission, in the Lords, 8th April ult.

THE LABORATORY DEPARTMENT OF WOOLWICH DOCKYARD, in consequence of he demand for stores, has considerably augmented its number of hands employed, which tatter now amount to about 3,000 men and boys. By the new rules, each boy employed in forming small-arm cartridges is required to produce, at least, fifty cartridges per hour. As a reward for the more diligent amongst them, 3d. extra per 100 is to be paid for all cartridges made by any boy over 4,000 per week.

A NEW "FRICTIONAL IGNITING BOLT," or "Hand-Grenade," (Captain Norton, Inv.) has been tried (13th April ult.) at Chatham. By means of a cord, fastened to this missile, it may be made to explode at any distance; its chief use being to discharge in the face of assailants when attempting to ascend the glacis or other outworks of a fort.

AN APPARATUS FOR SUBMARINE EXPLOSIONS [same Inventor], intended to supersede the Pickford fuze and voltaic agency, has likewise been recently under trial at Chatham.

IN CAPTAIN NORTON'S NEW "CONCUSSION FUZE," the advantage claimed is, that it will explode on being thrown into a clay mound, or into earth-works—advantages not to be obtained by any Moorson shell or the Boxer fuze. The shell fired at the last trial at Chatham (13th April ult.), exploded the instant it touched the bank, thus demonstrating the superiority of the invention.

A BREAKWATER AND FORTIFICATIONS are in rapid progress of construction on the Herne Heights, contiguous to Portsmouth Harbour. On the 13th April ult. the works were inspected by the Duke of Cambridge, attended by the Commanding Royal Engineer of the district.

STEAM HYDRAULIC ENGINEERING.

PALMER'S PATENT PUMP was, recently (and with complete success) used in raising the American ship *Isaac Wright*, sunk whilst on fire in the River Mersey, in the "Sloyne," near Liverpool, in Dec. last. The successful operation of the patent pump in raising the *Genova*, a London steamer, sunk in the river, led to its being employed for a similar purpose as respects the *Isaac Wright*; the dimensions of which are—length, 186 ft., beam, 38 ft., depth, 33 ft., and her tonnage about 1,300. There were 30 ft. of water in her stern, and 18 ft. amidships. The pump was placed on a platform amidships; the engine which works it being worked at only half-speed, in consequence of the position of the ship; yet, in 56 minutes the water was pumped out—over 3,000 tons of water having been ejected from the vessel in that period. At full-speed, it has been known to discharge 17,500 gallons a minute; and, with a 10 H.P. engine, it throws out from 70 to 75 tons in the same time. As soon as the ship was pumped out, she was floated, and run high on the beach, when all her cargo (which was not of a perishable nature) was safely removed; an operation which all previous attempts with the usual divers' apparatus had failed to accomplish.

AN ACCIDENT TO THE HYDRAULIC MACHINE (PRESS) during its action in the press-house (at Messrs. Curtis and Harvey's powder mills, near Hounslow), has been alleged as the probable cause of the late disastrous explosion (on the morning of the 30th March ult.) The work performed in the press-house was not, in practice, considered a very hazardous process of the manufacture, as the operation only consisted of pressing damp cakes of the powder under a hydraulic machine, until every grain had been compressed to the requisite density. For this purpose the powder is laid on a copper sheet, about 4 ft. square, to the depth of about an inch, when another sheet is put over it, and another layer of powder formed, and so on, until eighteen or twenty have been made, when the hydraulic machine compresses them altogether. The quantity of powder in the building at the time is estimated at from fifteen to sixteen barrels. The possible if not probable explanation of the cause of the explosion, to which we have alluded, is based on the state in which the hydraulic press was found on examination after the accident. A massive iron plate, about 2 in. thick, and 4 ft. square, and by means of which the pressure was exerted, equally, on all parts of the powder cake, was broken completely in half. If this occurred while the men were putting the pressure on the powder, it would, at once, account for the explosion. That this fracture was produced by the percussion is the more improbable, as the powder, as usual, appears to have exerted very little *downward* force. A large quantity of the powder must have been under the press, where it was confined, as in a shell, so that almost the whole force of the explosion was exerted outwards. The diameter of the ram of the cylinder of the press was 14½ in.; operation of the piston very slow, say 1½ in. or 2 in. in a minute; consequently but little danger from friction.

THE APPLICATION OF HYDRAULIC PRESSURE TO PROPEL GUN-CARRIAGES is under practical investigation at Woolwich Arsenal; a series of experimental trials with a new apparatus having this object, has, recently, been instituted by the Ordnance Select Committee, who have reported favourably of the invention.

THE PERFORMANCE OF THE POWERFUL PUMPING-ENGINES, set to work at the late disaster (by flooding), at the Brynock Colliery Pit, has been the theme of much laudatory remark. One of the engines pumped out at the rate of 990,000 gallons per minute. The cutting to be cleared is 95 fathoms in depth. In twelve hours the water was lessened about 5 ft. In two hours after the discovery of the accident, so rapid was the accumulation of the waters, that the shaft was flooded to the height of 63 ft.; by four o'clock it had reached 80 ft.

WATER-PRESSURE MACHINERY, whether on the principle of the unaided pressure of a column of water descending from its natural height or head, or in connexion with manual or steam-power, is now employed, on the most extensive scale, not merely, as in docks, for the cranage of goods, the working of entrances to ditto, &c., but also for various mechanical operations in connexion with many of the Government and other great establishments of this country. Nearly 1,200 hydraulic cranes, hoists, and other machines of that description are in actual use: and 125 steam-engines, collectively of more than 3,000 H.P., are now daily at work to supply the pressure for working them. The system has also been adopted in many of the principal railway-stations, not only for cranage, but also for working turntables, traversing-machines, waggon-lifts, hauling-machines, &c. It is also extensively used for raising and tipping waggons in the shipment of coal, for opening and closing swing-bridges, and for many other purposes. New forms of its application are continually being developed; and no doubt can now be entertained of its capability of still further extension. The form of mechanism which prevails to the greatest extent in these various applications of water-pressure consists of a hydraulic press, with a set of sheaves used in the inverted order of blocks and pulleys, the object being to obtain an extended motion in the chain, from a comparatively short stroke of piston.

WATER SUPPLY—(METROPOLITAN AND PROVINCIAL).

AT WORCESTER, A HANDSOME STREET FOUNTAIN, the gift of Alderman Padmore, has been erected, nearly in the centre of the Market House, at a cost of about £200. Internal diameter of basin on which it stands, 13 ft. Basin and sub-plinth of Darley-date stone.

AT STOURBRIDGE a fountain has been fixed, opposite the Market House. It is of cast iron, painted, and bears the inscription—"Let him that is athirst, come." Casting consists of a basin and cup. Waste water conveyed to a second basin at foot of pillar, for the use of dogs.

DRINKING FOUNTAINS IN THE METROPOLIS.—A public meeting of the new association for promoting this object, was held 12th April ult., at Willis's Rooms, St. James's Street, the Earl of Carlisle presiding. Resolutions in favour of the movement were passed; amongst them, one for the erection in the metropolis of free public drinking fountains, supplied with pure cold water, under the auspices of an association to be called the Metropolitan Drinking-Fountains Association. Subscriptions to the amount of upwards of £1,200 were announced as having already been received.

TWO PUBLIC DRINKING FOUNTAINS (the first, we believe, in London) have been opened on the incline leading to the South-Eastern Railway Company's terminus, at London Bridge. This good example will, we trust, be followed by other railway authorities.

ANOTHER METROPOLITAN DRINKING FOUNTAIN has been completed—namely, at the north-eastern corner of Snow Hill, in the wall of St. Sepulchre's Churchyard. The columns and sill are of polished red granite, with an alcove of white marble, the whole enclosed within an arch.

AT CHARING CROSS the erection of a PUBLIC DRINKING FOUNTAIN has been determined upon by the Vestry of St. Martin-in-the-Fields. The resolution for its erection was unanimously adopted (21st April ult.); and it was referred to the Works Committee to obtain plans and estimates.

THE KINGSTON WATER BILL was (March 31st ult.) read a third time in the House of Commons, and passed; read second time in Lords, 11th April.

THE POOLE WATER BILL was (March 31st ult.) read a third time in the House of Commons, and passed; read second time in Lords, 11th April.

AT SYDNEY, N.S. WALES, FORTY WATER FOUNTAINS, for the public streets, have been cast, and are about to be erected.

THE SUNDERLAND AND SOUTH SHIELDS WATER BILL was (8th April ult.) read in the Lords a third time, and passed.

THE GLASGOW CORPORATION WATER BILL passed the House of Lords 11th April ult.

THE KING'S LYNN WATERWORKS BILL was (15th April ult.), ordered to be read a third time in the Commons.

BOILER EXPLOSIONS.

A BOILER EXPLOSION occurred (Sunday evening, 17th April ult.) on the Eastern Counties line, in the cutting between Ilford and Romford (to mail down-train from London). Engine shattered, and wheels hurled to some distance; rails torn up, and driver scalded; but no lives lost, the train not being thrown off the line. Train supplied with an engine from the Romford station, and reached Chelmsford two hours after the usual time.

A BOILER EXPLOSION, attended with the loss of twenty lives, and with unusually frightful injury to many persons (chiefly factory-girls), occurred, 15th April ult., at the spinning-mill of Messrs. Edwards, of Scouringburn, Dundee. The flues of the boiler were thrown quite across a public road bounding the building on the east. The entire building above the (sunken) boilers, and consisting of a room for drying spun-yarn, and a flax-preparing flat, filled with heavy machinery, rose into the air, and fell down a mass of ruin. The dome of the exploded boiler was found 10 yards from its collapsed sides and bottom Cause of accident as yet unknown.

GAS SUPPLY, &c.

THE WOLVERHAMPTON GAS COMPANY have announced a reduction in price of 3d. per 1,000 cubic feet.

AT LONGTON, THE WORKS of the "Longton New Gas Company" have been opened, and the town lighted. Subsequently to which the Old Company have announced a reduction in price from 4s. 6d. to 3s., and the Stoke Company the same.

THE ST. PETERSBURGH NEW GAS WORKS, which are to be of great magnitude, and constructed upon the most improved principles, have been contracted for by Mr. Laidlaw, of the firm of R. Laidlaw and Son, of Glasgow, who will supply and erect the entire apparatus and pipes required. There will be four telescopic gasometers, each 100 ft. in diameter, and two each 60 ft.: with ample accommodation to double this number when required. The main pipes will extend to upwards of 200 miles in length, the largest of which will be 36 in. in diameter.

THE EDMONTON GAS BILL was read (in the House of Commons) a second time, and committed, 28th March ult.

THE BURY ST. EDMUND'S GAS BILL was, 8th April ult., read a second time (in the Commons), and committed.

THE SHREWSBURY GAS COMPANY are erecting an additional gas-holder, 60 ft. in diameter, and 24 ft. in depth, upon the double or telescope principle, and capable of containing 135,000 cubic ft. of gas. Contractor, Mr. J. Holmes, of Bomere Heath; cost, about £2,000.

THE CARDIFF GAS COMPANY, at its 44th half-yearly meeting, declared the usual dividend of £10 per cent. on the old capital, and £8 per cent. on the new. The Directors have agreed for the purchase of 4½ acres of land, situate between Cardiff and Penarth, for extending the Company's works.

GAS ENGINEERING—(HOME AND FOREIGN).

METROPOLIS GAS SUPPLY.—The Select Parliamentary Committee, "to investigate as to the Metropolitan Gas Supply, and the district arrangements of the Metropolitan Gas Companies," assembled 25th March ult. The chief points of evidence related to the following subjects:—the coalition of the gas companies in 1857;—the complaints (in the Chelsea district in particular), that since the districting arrangements of the gas companies there had been a change from common gas to cannel gas, for which, although of greater illuminating power, an increased price was charged by the companies;—and the statements of the accounts of the several [13] gas companies, namely, the Imperial, Phœnix, South Metropolitan, London Chartered, Commercial, Surrey Consumers' Equitable, Western, Great Central, City of London, Ratcliff, and Independent.

THE SOUTH ESSEX GAS COMPANY'S CREDITORS have been required to prove their claims before V.C. Sir W. P. Wood.

THE COUNTY AND GENERAL GAS COMPANY, on the other hand, announce a half-yearly dividend at the rate of £5 per cent. per annum.

The Whole Gas Rental of the Metropolis is [evidence of Mr. John Hughes, C.E., in Gas Committee] estimated at £1,238,000.

12,500 Tons of Coals [estimated cost, £10,000] will produce 115 millions of cubic feet of gas, which, deducting one-sixth for leakage, leaves 16,170,000 feet of gas, producing, when charged for at 4s. 6d. per 1,000 feet, £21,962; and, deducting 2s. 6d. per thousand for cost of manufacture, leaves a balance of £7,287 as profits (on an outlay of £10,000 capital).

The Gross Capital of all the [13] Companies is £4,739,776, and the share capital, £4,601,843. The capital of the Imperial Company is the largest, being £1,200,000. Average Dividend [on authority of the "Share List," published under sanction of the Committee of the Stock Exchange] paid by the whole of the Companies, £6 9s. per cent. The Imperial is positively stated to pay a dividend of £10 per cent.

A New Gas-baking Oven, to prevent injury to pastry, &c., from smoke, soot, &c., has been patented; in this arrangement the gas circulates with the smoke, through the flue, in a serpentine direction, round closed ovens or compartments—two, three or more of these being placed over each other, and separated by the winding-flue, with a gas-jet for each compartment or oven, consuming the smoke from below, and sending its own to the next above: the remnant vapours having their exit at top, so that no portion of them can have access to the articles in the several compartments.

The Kingston-upon-Thames Gas Bill passed the House of Commons, 11th April ult.

The Wantage Gas and Coke Company have resolved to reduce their price of gas from 8⅝d. to 7s. 6d. per 1,000 ft. from the 4th of July next.

The Boston Gas Company are about to construct a new wrought-iron gasometer 85 ft. in diameter, and 24 ft. deep. Cost per tender (accepted) £1,500.

Uniformity in Gas-Meters.—By the provisions of a Bill, just introduced (by Lord Redesdale) into Parliament, "to regulate the measures used in the sale of gas,"—models of the legalised measures are to be made and verified under the direction of the Treasury. All contracts for the sale of gas, made and to be made by these meters, registering within 2 per cent. variation from the cubic foot, containing 62·32 lb. avoirdupois weight of distilled water, weighed in air, at the temperature of 62 deg. of Fahrenheit's scale, the barometer being at 30 in.; and by any meters registering within 2 per cent. variation from multiples or decimal parts of such cubic foot are to be valid in law. Power is given to justices and inspectors to enter houses, and inspect gas-measures and meters.

The Scarborough Gas Bill, 15th April ult., passed the House of Commons

BRIDGES, VIADUCTS, &c.

The New Westminster Bridge is, somewhat indeed, slowly, but steadily progressing. The greater part of the iron arches for the western side have been erected, and carefully fitted together at Messrs Cochrane's works, near Battersea. The spring of these new arches will commence at 2 ft. above high-water mark. In the central parts of the arches, where the traffic would, otherwise, subject them to constant vibration and frequent percussion from moving loads, the use of cast-iron has been avoided; the arches have therefore been designed with crowns or central ribs of wrought-iron boiler-plate, of immense strength and stiffness, whether regarded as ribs or girders; these central ribs vary in span, with that of the arch; in the centre they are 52 ft. long, by 28 in. deep. At either end, in the three arches, they are only 42 ft. long by 22 in. deep. Each span is of rolled-iron 1¼ in. thick. Full load strain of the arches is at the rate of 3 tons to the square inch: but all the wrought-iron portions of the crown are tested with a compressive and percussive strain of more than 12 tons to the square inch, or nearly 2,000 tons to the square foot. Each (wrought-iron) girder is calculated to support 100 tons; and, as there are fifteen in each, the strength of the whole mass is made equal to about thirty times the amount of strain which the ordinary run of metropolitan traffic can ever put upon it. Expansion between the joinings of the arches is provided for by pads of vulcanised india-rubber, placed between. A change in the temperature of 50 deg. would increase the length of the centre arch half an inch; an amount of expansion which, if not provided against, would be quite sufficient to unsettle the strongest bridge in the world. Total of Materials employed [when bridge completed]. Timber used in the bearing-piles, 45,700 cubic feet; Cast Iron, 1,600 tons; Wrought-iron, 1,500 tons; Granite and other stone (for piers and abutments), 165,000 cubic feet; Brickwork, in Portland cement, 21,000 cubic yards; and Concrete (also in Portland cement), 30,000 cubic yards,

The [Comparative] Widths of the Metropolitan Bridges are;—Entire width of London-bridge, 54 ft.; of Blackfriars, 42; of Waterloo, 43; Vauxhall, 36; Southwark, nearly same as Waterloo; the extreme width of the new Westminster-bridge will be 85 ft.

At the Kehl Bridge, over the Rhine, a fire broke out on the evening of the 8th April ult., in the railway works, threatening to destroy the fruits of five months' gigantic works for the temporary bridge. The fire broke out on board one of the boats, containing a steam pile-driving machine, moored close to the temporary bridge; and, in an instant, the flames took the scaffolding, and communicated with the main work, which burnt fiercely. By great exertions of the workmen, pontoon-men, &c., the burning vessels were drifted off, and the temporary bridge, already on fire, escaped with only partial damage.

The Londonderry Bridge Bill was, 8th April ult., read in the Lords a third time and passed.

Westminster New Bridge Bill.—In the House of Commons, 8th April ult., Lord J. Manners moved, that in the case of this Bill the examiners have leave to sit, and proceed forthwith. Sir H. Willoughby understood that £138,000 had already been spent on the works, and that £178,000 more would be required. He wished to know how the deficiency would be supplied; as likewise whether the report was true as to the engineer, contractor, and surveyor, being one and the same person? In reply, Lord J. Manners said, a further vote would be required; that the contractor, engineer, and surveyor, were three different persons. 15th April ult., Lord J. Manners, in moving the second reading of the Bill, stated that the total estimate for the works amounted to £316,000; but of that sum, £96,000 would still be required to be voted by Parliament; that the superstructure had been contracted for by the Messrs. Cochrane, and the piers and foundations were being completed by Mr. Page.

The Approaches to the New Bridge, as authorised by the new Bill, necessitate the removal of several houses in Parliament Street, Bridge Street, and New Palace Yard, including Fendall's Hotel; these erections (specified in the Government Bill, printed 8th April ult.) are to be removed, in order to facilitate the western approaches.

The Victoria Bridge across the St. Lawrence, at Montreal, Canada, will, according to the recent circular statement of the directors of the Grand Trunk Railway, cost £1,350,000. The bridge, and the extension to Sarnia of 70 miles, will, on same authority, be opened for traffic by October next.

The Opening of the "Royal Albert" Bridge, on the Cornwall Railway, is fixed for the 2nd of May inst.; the presence of His Royal Highness Prince Albert at the ceremony is expected. After the opening, trains for the public will run between Plymouth and St. Germans.

A Bridge and Railway are to be substituted, with the consent of the London and North-Western Railway, for carrying the West London Line over the Great Western, in place of the present level-crossing.

HARBOURS, DOCKS, CANALS, &c.

No. 3, Dock, Chatham Dockyard, has been lengthened 60 feet, in order to admit vessels of war of a large class for repairs.

The "Severn" Sailing Frigate, 50 Guns, has been docked in the above, for the purpose of being lengthened and converted into a screw steamer.

Greenwich and South-Eastern Docks Bill.—The Lords of the Admiralty assent to this Bill, on the following conditions:—1. No alteration of the entrances from the Thames to the Docks to be made without previous approval and sanction of the Admiralty. 2. No works in the River Thames to be commenced until detailed plans of same have been submitted to, and approved of by the Admiralty; and then only on plans so approved. 3. That a self-registering tide-gauge be erected by the Company near one of the entrances from the river to the Docks, at a site to be approved of by the Admiralty. 4. That no alterations be made in proposed works, as shown in Parliamentary plans, without the limits of deviation set out, where the same approach within 100 yards of high water-mark, without previous approval of the Lords of the Admiralty.

The Harbour Works at Kurachee (India) have been commenced; the Secretary of State for India having given instructions to that effect, owing to the daily-increasing traffic of that Port.

The Whitehaven Harbour and Town Bill, in the House of Commons, was read a third time, and passed 28th March ult.

Swansea Harbour Trust Bill, in the House of Commons, was read a second time, and committed 28th March ult. (order limiting time of second reading of Private Bills being suspended in this case).

The Charleston Harbour, Forth and Clyde Navigation, and Gateshead Quay Bills, were respectively (5th April ult.) ordered for third reading, in the House of Commons.

Greenock Dry Dock.—A recent accident to the engine for pumping out the water from the dry dock has caused an interruption of work for eight days; but, the pumping-engine having been repaired, it cleared, in one night, the dock of the water that had been there during that time. On account of this accident, slight as it may appear, and which may occur any day, the large ship *John Bunyan* was forced to remain in the dock, unable to be proceeded with in her repairs, and several other vessels have been compelled to go to other places to be repaired, owing to the want (at Greenock) of other dock accommodation.

The Mersey Docks and Harbour Bill was (4th April ult.) read a third time in the Commons.

The Tyne Imbrovement Bill was (4th April ult.) read a third time in the Commons.

The Fishguard Harbour Improvement Bill passed its third reading in the Commons 15th April ult.

The Sunderland Docks [and Wear Navigation] Bill was (7th April ult.) ordered for third reading in the Commons: read a third time in the Commons 11th April ult.

The Greenwich and South-Eastern Docks Bill was (8th April ult.) read a third time in the Lords, and passed.

The Gateshead Quay Bill was (8th April ult.) read in the Commons a third time, and passed.

The Charleston Harbour Bill was (8th April ult.) read in the Commons a third time, and passed.

The Whitehaven Harbour Bill was (8th April ult.) read in the Commons a third time, and passed. On the 14th April ult. this Bill passed in the Lords.

The Suez Canal, it would appear, is not progressing favourably. The Bedouin Arabs having, so at least it is reported, opposed the staking out of the canal, and done much injury to its works. A previously published unfavourable report, however, to the effect that the Viceroy of Egypt had rejected the formal application of M. de Lesseps to commence the works, has turned out to be unfounded, or at all events premature.

The Victoria London Docks Bill passed in the House of Commons 15th April ult.

The Chichester Harbour Embankment Bill was ordered for third reading in the Commons, 11th April ult.

The Commercial Docks Amendment Bill was (15th April ult.) read a third time, and passed, in the Commons,

Canals in India, constructed and opened for traffic since 1848. In Madras, 512 miles; cost 25.71.960 rupees. In Bombay, none. In Scinde, 223 miles; cost 2.21.089 rupees. In Bengal, 12 miles, cost 79.572 rupees.

The [New] Greytown and Nicaragua Canal.—By late advices from Greytown, it appears that M. Belley, the eminent French engineer, accompanied by a large staff, had (18th March last) arrived at Greytown for the purpose of opening this new canal, which, when finished, will become a powerful competitor with the American railway from Chagres to Panama.

MINES, METALLURGY, &c.

Gold Mines at Tonquin.—Recent advices from Hong Kong announce the discovery of rich gold-mines in the neighbourhood of Tonquin.

"Shot Gold" in abundance is announced from New York, as having been recently discovered on the banks of the Arkansas River.

Port Philip, Gold [Quartz-crushing] Company.—Quantity of quartz crushed in December last was 1,602 tons. Receipts of the month, £3,774 3s. 4d.; expenditure, 2,419 2s. 10s.; showing a profit of £1,355 0s. 6d.

The "Levant Mineral" Company, at their recent meeting, declared a dividend of 10 per cent.

A Recent Discovery of Auriferous Land has been made, South of Melbourne (Australia). The site is in the Dandenong Ranges; and profitable gold-workings are being prosecuted. A sample of the dust, taken from the bed of the Little Yarrow Creek, is described as coarse in grain, and mixed with small particles of quartz: colour bright; and, altogether, indicates an excellent quality of gold. Claims have been marked out along 3 miles of the creek. Distance of the new diggings from Dandenong about 18 miles, and from Melbourne, 43.

The Diggings at Indigo Creek (a small tributary of the Murray, in the Ovens district; as also those at Crowlands, in the neighbourhood of the Pyrenees ranges) have failed to realise the hopes their (recent) discovery had awakened. Their (originally promising) yield of gold has fallen off, and the eagerness to work them has proportionately declined.

The Coal-Fields of Great Britain, according to the most (recent) statistical investigations, present a superficial area of 31,065 square kilometres; and produce 63,000,000 tons per annum. Of the enormous (home) consumption of coal, some idea may be formed from the local demands of Manchester and its environs alone, where, with a radius of 32 kilometres, steam-power equal to that of 1,200,000 horses is in constant action, requiring 30,000 tons of coal per day, equivalent to 9,000,000 tons per annum. In the manufacture of salt, there are consumed about 3,000 tons of coal per day,—say 950,000 tons a year. The Transatlantic steamers of Liverpool, &c., consume 700,000 tons per annum. The manufacture of gas, and the foundry-works, absorb a minimum of 10,000,000 tons. The exports of coal from Great Britain, in 1858, amounted to 6,078,000 tons. Assuming the above data as the basis of calculation of probable future supply, it appears that the produce of the British coal-fields will amply suffice for the consumption of the next 4,000 years.

A Fearful Colliery Accident [by Flooding] occurred (6th April ult.) at the Main Colliery, near Brynock, about 2 miles from the town of Neath; owners, Messrs. Fox, Redwood, and Co.; number of men and boys in the pit, at the time of accident, 80; of ictims (by drowning), 25. Cause of disaster—the "borers" engaged in exploring the drifts, with a view to obtaining an additional pit as an upcast-shaft, suddenly striking into the workings of an old colliery, whence a rush of undrained-off water soon overflowed the entire pit. By dint of the greatest exertion (train after train being sent down the shaft with the utmost speed) fifty-five men and boys, and two horses, were brought up; but the remainder perished. In two hours the water flooded the shaft to the height of 63 ft., and soon afterwards rose up to 80 ft. Two powerful engines were set to work to drain the water.

Copper.—A new undertaking, the Devon, Kapunda, Copper and Silver Lead-Mining Company (limited), is announced. Proposed capital, £30,000. This is a revival of the old Devon Kapunda Company, who some time since relinquished the then existing works, after an expenditure of upwards of £20,000.

A "Great Central Mining Company of Devon" (limited) has started its prospectus. Proposed capital, £30,000, in £1 shares. Works, at Ilsington, near Newton Abbott; said to contain a valuable copper-lode.

A Colliers' Strike occurred (6th April ult.) at Hunwick, near Bishop Aukland. The whole of the pitmen employed at the Newfield and Binchester Collieries (to the number of about 300) struck work, in consequence, as they alleged, of the measure-tub, by which their coals had previously been measured, being removed, and a larger one substituted.

Medicinal Iron.—In the Tyrol a factory has been established for producing, by mechanical means, a powder of iron, sufficiently fine to be used in medicine, as a substitute for that obtained by the reduction of an oxide of iron, by means of hydrogen. It has this difference, as compared with the powder produced by means of hydrogen, that it will not burn spontaneously in air, but it will do so easily when suspended to the poles of a magnet. If the latter is plunged into the powder, and a lighted match be then applied to the powder adhering to the magnet, the iron will burn readily and brilliantly, and when the magnet is shaken, the particles fall off in the form of beautiful sparks.

Australian Gold.—The quantity of gold-dust received at the Sydney Branch of the Royal Mint, for the purpose of coinage during the year 1858, amounted to 342,430 oz., against (in 1857) 223,215 oz. Of gold-dust (delivered by the escorts*) the total amount received from the several (Australian) gold-fields during the year ended 31st December, 1858, was 255,535 oz.; being an increase of 107,409 oz., or about 72 per cent. in favour of last over preceding year.

The Scotch Iron Trade, for the past quarter (to 31st March, 1859), shows, on the whole, a satisfactory increase. The average price (of pig iron) in January was 53s. 6d., in February, 51s. 11d., and March 52s., against 54s. 7d., 56s. 3d., and 57s. 1d., in these months respectively last year. Notwithstanding the falling off in the exports to France, Italy, and Germany, in consequence of the perturbed condition of Europe, the total deliveries of pig iron amount to 208,000 tons; showing an increase of 15,000 tons over the corresponding period of 1857, when the price was 75s. per ton. Owing to the stoppage of several furnaces, the production is only 232,000 tons; showing a decrease of 19,000 tons, when compared with the preceding three months. Local consumption rapidly enlarging, now averaging fully 7,000 tons per week. Several large contracts recently, on Russian and Indian account, for cast-iron pipes and railway chairs.

Price of Iron.—The concluding meeting of iron-masters, for the current quarter, was held at Dudley, 16th April ult. Although mills and forges are at present in pretty full work, the iron-masters do not conceal the fact that the trade is flat, and that there is a prospect of a fall in prices—that pig iron is quite half-a-crown a ton lower than it was three months ago; but, in a great number of instances, the sales effected were at 5s. below the price which then ruled, it being only such of the pig-masters as make a good quality who could obtain £3 12s. 6d. per ton.

Some unusually Immense Cylinders have recently been cast at the Works of Messrs. Watt and Co., Soho, for the engineers of the City of Dublin Company's New Irish Mail-Packet Steamers, to be shortly placed on the Holyhead and Dublin route. Internal diameter of the cylinders [intended for engines on the oscillating principle], 96 in. (piston having 7 ft. stroke), being considerably larger than those of the Great Eastern, which are only 84 in. in diameter, and have a 4 ft. stroke. One of the "monster" cylinders in question was cast a few weeks ago, and is now in process of having the roughness of the casting removed. Although no less than 33 tons of iron were poured into the mould, not the slightest trace of an air-bubble is visible on any part of the dressed surface, which is perfectly free from specks of any kind. The operations of casting the cylinders are thus performed:—in one of the large brick-lined casting pits the mould is prepared, the most minute precautions being taken for giving vent to the gaseous vapours which are generated inside the mould on the entrance of the metal, otherwise a "blow-up" would be the infallible result. The master-caster gives the signal; one furnace after another is tapped; and down a loam-lined gutter comes the bright red stream, shooting out brilliant corruscations in all directions; but its course is stayed before it comes to the mould. The boiling iron is allowed to accumulate in a capacious "sow" at the edge of a pit, where it seethes for a minute or two. On a given signal, the opening of a sluice allows the metal to rush into the mould in a steady continuous stream: the dilated atmospheric air roars with terrific din out of the vent-holes, kept open by ten or twelve men standing, for that important duty, on the top of the mould. In about a minute the 30 tons of molten iron have run from the "sow," and all that remains for the casters to do is to pour sundry cauldrons of metal into the mould, as the boiling metal gradually consolidates and settles down. In a few days the cylinder is raised from its bed by powerful machinery, and transported to the fitting-shop.

* The Victoria *Argus* gives the gold-field statistics for 1858, thus,—Escort Returns amounted to 2,295,053 oz. against 2,478,826 oz. for 1857. Weekly average production was 44,841 oz. against 47,670 oz. for 1857. Shipments [of gold] for the year amounted to 2,504,812 oz., or 104 tons 7 cwt. 1 qr. 9 lbs. 4 oz. troy, against (in 1857) 2,752,869 oz., or 114 tons 14 cwt. 8 lbs., and (in 1856) 3,007,281 oz., or 125 tons 6 cwt. 6 lbs. 9 oz.

APPLIED CHEMISTRY.

Weaving Patterns by Electricity.—Improvements in the "electric loom," invented by Chevalier Bonelli, Director of the Sardinian telegraph, shown at the Paris Exhibition of 1855, have been made by M. Froment, and communicated to the Académie des Sciences. In this invention, the Jacquard cards are replaced by a thin sheet of tin, on which the design to be reproduced on the fabric is figured with varnish or isolating ink. The beat-up of the batten brings a metallic comb, formed of small separate teeth, into contact with the design, when some of the teeth touch the varnish of the design and others touch the metal; and those teeth, in contact with the metal, alone give passage to the electric fluid supplied by a Bunsen pile, and convey it to the small electro-magnets with which they are connected by means of a thin copper-wire. These electro-magnets act upon an equal number of small iron-rods, to keep them out of the way of the wires of Jacquard, while those teeth which come in contact with the varnish of the pattern are allowed to project against the wires of the Jacquard, to act upon them in the same manner as the cards now used. When the Emperor and Empress were lately visiting the *ateliers* to inspect the loom, M. Froment, as a proof of the ease with which new patterns can be applied, replaced (without interrupting the work) the design in course of execution by a band of tin, on which he had written the words Napoleon III. which were seen to follow on the fabric the flowers composing the first design.

Prevention of Pitting in Small-pox.—A new remedy for this purpose has been recently (29th March ult.) communicated to the Glasgow University Medical Society, by Mr. John Brunton, M.A., Clerk to the Infirmary, who stated that he had tried the new prescription repeatedly, and with the most unequivocal success. It consists of glycerine, nitrate of silver, and collodion.

A "Safe Enamel" [Email Inoffensif.]—As a substitute for the occasionally poisonous lead-glaze for earthenware, &c., in present use, is proposed by M. Hardsmuth. It is thus prepared: Boracic acid, 15 kilogrammes; calcareous spar, 15 kilogrammes; clay, 5 kilogrammes; wood-charcoal, 1 kilogramme. Reduce the mixture to powder, which calcine to complete fusion; let it cool, and then again pulverise;—to be applied in same manner as the ordinary lead-glaze.

Mildew in Grain Removed.—The remedy, recently adopted by a farmer of l'Allier, is thus described by him. The grain affected is to be slowly and intimately mixed with a small quantity of pulverised charcoal, and the mixture left for fifteen days to work: it is then passed through the winnowing-machine, and thus grain is obtained exempt from all bad smell, and without the slightest remaining trace of mildew.

ACCIDENTS FROM MACHINERY.

Unprotected Machinery.—In Chatham Dockyard, 5th April ult., one of the workmen was employed in attending to the ponderous auxiliary engine for pumping the water out of the docks, when his clothes came in contact with a portion of the same, and he was instantly drawn in and killed; the machinery, before it could be stopped, tearing him limb from limb.

In Mcfie's Sugar-Refinery, Bachelor-street, Liverpool, a workman was recently killed by being caught in some part of the machinery in motion. His legs were amputated below the knee, and his shoulder-bones and some of his ribs crushed.

Travelling Cranes.—A fatal accident occurred (18th April ult.) at the new Westminster Bridge works. The workmen were moving a block of stone with a travelling-crane, when the machinery gave way, and the stone fell, with a tremendous crash, on some pieces of timber. One man was struck down, and fell into the water; and several others were injured. The body of the former is supposed to be underneath the ponderous stone.

A Serious Accident at Woolwich Dockyard occurred (20th April ult.) to two shipwrights employed in the construction of the *Barossa* screw steam-vessel. By the fall of a piece of timber, one of the men had his legs broken, and the other sustained a fracture of the skull. Both the sufferers are now in the Marine Hospital.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 16th December, 1858.

2880. R. Wilson, sen., and R. Wilson, jun., Livesey-st., Manchester—Preparation of leather in combination with india rubber and other materials, for the manufacturing of hose pipes.

Dated 8th February, 1859.

350. J. Hosking, Walworth-common, Surrey—Manufacture of lamps.

Dated 19th February, 1859.

460. T. Earle, Clapham, Surrey—Apparatus for conveying signals to railway trains in motion.

462. W. Basford, Burslem, Staffordshire—Drying bricks and tiles preparatory to their being burnt.

Dated 24th February, 1859.

498. H. B. Barlow, Manchester—Apparatus for condensing steam.

Dated 25th February, 1859.

516. G. Peover, Wilmington-sq., Clerkenwell—An improved optical instrument, being an improvement upon the kaleidoscope.

Dated 1st March, 1859.

586. E. J. Hughes, 123, Chancery-lane—Preserving animal food, poultry, game, fish, and fruit.

Dated 2nd March, 1859.

546. J. T. Carter, Belfast—Machinery for crushing, bruising, and preparing flax, hemp, and other fibrous materials.

Dated 8th March, 1859.

600. J. King and A. Wilcock, Moss-mill, near Rochdale, Lancashire—Machines used in preparing, spinning, and doubling cotton.

LIST OF NEW PATENTS.

602. W. Halliday, Wakefield—Apparatus for preventing smoke and economizing fuel.

604. C. Mills, High-street, Camden-town—Pianofortes.

606. E. Deane, 1, Arthur-st. East, London-bridge—Transmission of gas and other fluids.

608. B. M. Belling, 55, Queen's-rd., Bayswater—Hardening india rubber for the bases of teeth.

Dated 9th March, 1859.

609. J. Pilbrow, Tottenham, Middlesex—Methods of obtaining and applying motive power.

610. J. A. Williams, Baydon, Wiltshire—Apparatus for cultivating land by steam power.

611. Sir W. G. Armstrong, Newcastle-upon-Tyne—Rifled ordnance and its projectiles.

612. J. R. Nicholson, Redditch, Worcestershire—Manufacture of needles.

613. J. Erwood, 132, Goswell-st., Clerkenwell, and J. Skertchly, Ashby-de-la-Zouch, Leicestershire—Manufacture of glass, sand, and emery papers and cloths.

614. G. C. Pearce, Cyfarthfa, Glamorganshire—Cornets, trumpets, and other wind instruments.

615. J. S. Russell, Great George-st., Westminster—Building ships and other vessels.

617. A. V. Newton, 66, Chancery-lane—Machinery for rolling horse-shoe iron.

618. W. E. Newton, 66, Chancery-lane—Billiard tables.

619. H. Fisher, Birkenhead—Apparatus for cutting thin sheets of metal into strips, and for tempering sheets or strips of metal.

Dated 10th March, 1859.

620. J. C. Martin, High-st., Barnes, Surrey—Manufacture of cannon and small fire-arms.

621. J. Yuill, Glasgow—Saddle-trees.

622. R. F. Woodward, Birmingham—Manufacture of certain kinds of scale-beams.

623. H. Lodge, Liverpool—Improved means of protecting ships, batteries, and other constructions or buildings from the effects of projectiles of various kinds.

Dated 11th March, 1859.

624. J. H. Burton, Enfield Lock, Middlesex—Breech-loading fire-arms.

625. J. C. Haddan, 4, Cannon-row, Westminster—Casting mortars and cannon.

627. S. Wheatcroft, Brudenell-pl., New North-rd.—Construction of goffering and rouching machines in order to render them self-registering and self-indicating.

629. F. Clarke, Norland-sq., Middlesex—Apparatus for cutting, drying, and preparing peat to be used as fuel.

630. A. V. Newton, 66, Chancery-lane—An improved construction of steam-engine.

Dated 12th March, 1859.

631. J. Cunliffe and F. Piggott, Manchester, and G. Mallinson, Salford—Manufacture of ornamental woven fabrics.

632. W. E. Newton, 66, Chancery-lane—Endless chain propellers for boats and other vessels.

633. W. E. Newton, 66, Chancery-lane—Manufacture of shoes and other coverings for the feet.

634. J. Palmer, Sutton Coldfield, Warwickshire—Trap for catching animals, birds, and fishes.

635. J. T. Calow, Staveley, Derbyshire—A compound action in cage machinery, with the apparatus connected therewith, having a perforated shield for saving life and property in the event of a rope, band,

or chain breaking, or the engineman drawing the cage too bigh at coal or other shafts, where slides are applicable.
636. J. Thornton, Liverpool—Machinery for the manufacture of bricks and tiles.
637. J. Court, Brompton-row, Middlesex—Nibs for gas-burners.
638. R. Allison, Birmingham—Apparatuses for boring and sinking.
639. J. Macnab, Linlithgow, N.B.—Telegraphing or signalling apparatus.

Dated 14th March, 1859.

640. R. Waller, 50, Baker-st., Portman-sq. — Joining leather, flexible, and textile materials, for the production of boots and shoes.
641. R. A. Brooman, 166, Fleet-st. — Method of treating wool and other fibres in order to form threads.
642. A. Tylor, Warwick-lane, Newgate-st.—Apparatus for regulating the supply of water to water-closets and other vessels.
643. T. Lightfoot, Accrington, Lancashire—Fixing colors on woven fabrics or fibrous materials.
644. D. Joy, Leeds—Hydraulic engines and meters.
645. C. H. Hurst, Victoria-ter., Royal-rd., Kennington-park—An improved wrench or spanner.
646. E. Smith, Dudley Port, Staffordshire—Preparing furnaces used in the manufacture of iron.
647. T. Patstone, Birmingham—Shades or glasses for gas and other lamps.
648. J. S. Dawes, Smethwick-house, near Birmingham—Combination of arrangements for the better securing and collecting of night-soil or town manure.

Dated 15th March, 1859.

649. W. Langton, 142, Wharf, Belvidere-rd., Lambeth—Manufacture of keys and wood fastenings used in constructing railways.
650. C. Desurmont, Seclin, France, and C. Goudeau, Alost, Belgium—Looms for weaving.
651. G. B. Galloway, Newcastle-on-Tyne—Manufacture of fuel, and working steam engines more economically.
652. C. Ritchie, 143, Strand—Calculating machines.
653. W. Clark, 53, Chancery-lane—Apparatus of electric lamps or lights.
654. B. Rider, 61, Redcross-st., Borough—Hats, caps, and other coverings for the head.

Dated 16th March, 1859.

655. J. Dixon and R. Clayton, Bradford—Rolling iron and steel for manufacturing railway wheels.
657. W. Robertson and J. G. Orchar, Dundee—Weaving.
658. C. Parker, Dundee—Looms for weaving.
659. J. Parker, Claremont-cottage, Lilford-rd., Camberwell, Surrey—Lever sails, aad submerged feathering propellers.
660. I. Ash, 17, Great Bridport-st., Blandford-sq., Middlesex—Construction of locks and latches.
661. F. Mordan, Goswell-rd., Middlesex—A means of keeping a stopper connected with a bottle, jar, or such like receptacle, when removed from the mouth thereof.
663. J. Fuller, Reading, Berkshire—Churns.
664. W. Avery, Birmingham—Manufacture of screws.
665. J. Michael-Denys, 4, South-st., Finsbury—Construction of railway-crossings.
666. E. Anscombe, 95, Westbourn-st., Pimlico—Apparatus for taking an accurate delineation of any view or object in open air or otherwise.
668. J. Clark, Newton-heath, near Manchester—Manufacture of fabrics in which compounds containing india rubber are used.
669. G. Hamilton, St. Martin's-le-Grand, and W. H. Nash, Poplar—Tumbler or lever locks.
670. H. Bessemer, Queen-st.-pl., New Cannon-st.—Manufacture of crank axles.
671. T. W. Miller, H.M. Dockyard, Portsmouth—Blocking or securing ships and other vessels whilst being removed.

Dated 17th March, 1859.

672. C. Defries, Houndsditch—Improvement in lamps.
673. C. Garnett, Cleckheaton, Yorkshire—Machinery for ginning cotton.
674. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for folding and stitching sheets of paper.
675. E. T. Hughes, 123, Chancery-lane — Apparatus for crushing sugar-canes and other materials.
676. R. A. Brooman, 166, Fleet-st.—Treating barley so as to obtain new alimentary substances therefrom.
677. T. Skelton, Plaistow, Essex—Steering apparatus.
678. A. G. Hutchinson, West Derby, Lancashire—Counteracting damp in buildings.
679. P. Larochette, Paris—Machinery for brewing.
681. A. Warner, 31, Threadneedle-st., and W. H. Tooth, Sumner-st., Southwark—Manufacture of iron.

Dated 18th March, 1859.

683. W. Cook, Kingston-upon-Hull—A smoke consumer.
684. W. B. Taylor, Ballymena, Antrim, Ireland—Looms for weaving.
685. Sir W. G. Armstrong, Knt., Newcastle-upon-Tyne—Means of igniting explosive projectiles.
687. J. Molesworth, Rochdale—Telegraphic communication.
689. J. Hinks and G. Wells, Birmingham—Improved pen-holder.
690. R. Mushet, Coleford, Gloucestershire—Metallic alloy.
691. R. Mushet, Coleford, Gloucestershire—Manufacture of cast steel.
692. A. L. Thirion, Asche en Refail, province de Namur, Belgium—Water, wind, steam, and hand mills.
693. C. Lambert, Sunk Island, Yorkshire—Corn and seed drills.
694. J. W. Duncan, Grove-end-rd., St. John's-wood, and J. E. A. Gwynne, Hanover-ter., Regent's-park—Apparatus for the generation, application, and condensation of steam.

Dated 19th March, 1859.

695. T. Allen, Waingate, Sheffield—Petticoats.
696. W. B. Gingell, 37, Corn-st., Bristol—Form of metal bars used for the stiles, rails, heads, and sills of window sashes.
697. E. L. Benzon, Sheffield—Casting of steel.
698. S. Stein, Chapel-place, Poultry — Manufacturing a resinous carton or pasteboard from vegetable matter.
699. H. Whitaker, Newman-st.—A new musical instrument, to be called "The Cherubine Minor."
701. W. Haigh, Reddish, Lancashire—Improved manufacture of paper.
702. J. Howden and A. Morton, Glasgow—Apparatus for obtaining and regulating motive power.
703. R. Mushet, Coleford, Gloucestershire—Manufacture of cast steel.
704. W. and S. Pickstone, Radcliff bridge, near Manchester — Stiffening, sizing, filling, or weighing textile fabrics.
705. A. V. Newton, 66, Chancery-lane—Propelling vessels.
706. W. C. Cambridge, Bristol—Chain harrow.

Dated 21st March, 1859.

707. W. Haggett, Sherborne, Dorsetshire—Method of treating metals and other materials to increase their strength.
708. A. Baucq, Marchiennes, France—Maintaining graters mechanically.
709. W. Hudson and C. Catlow, Burnley, Lancashire—Looms for weaving.
710. R. Whittaker, Lennox Mill, Stirling, N.B.—Construction of metallic rollers or cylinders and mandrills for printing.
711. G. Ferguson, Strand—Application of certain materials for the destruction of insects and vermin.
712. J. Roberts, Staleybridge, Chester—Packing for pistons.
713. S. Leoni, St. Paul-st., Middlesex — Manufacture of useful and ornamental articles, surfaces, and works.
714. J. Bickerton, Oldham—Opening and securing window sashes.
715. G. Gregg, Sheffield—Currying or manufacturing leather.
716. W. Warne, J. A. Fanshawe, J. A. Jaques, and T. Galpin, Tottenham, Middlesex — Preparation of materials for covering and insulating wires or conductors used for telegraphic purposes.
717. W. Rhodes, Wade-st., Thornton-rd., Bradford—Fire-proof safes.

Dated 22nd March, 1859.

718. G. P. A. Lutz, Rue Ménars, Paris—Veils.
719. J. Davis, 18, Frith-st., Soho—Musical instruments.
720. P. Tagliacozzo, 27, Broad-st. buildings — Metallic pens.
721. W. A. Gilbee, 4, South-st., Finsbury—Apparatus for stretching and polishing silk thread.
723. F. Ashford, Commercial-rd. East, London—Means of fastening and securing treasure or bullion cases.
724. J. T. Pitman, 67, Gracechurch-st.—Springs for railroad cars.
725. E. Maynard, Washington, U.S.—Improving breech-loading fire-arms.
726. S. Newington, M.D., Ridgway, Ticehurst, Sussex—Apparatus for distributing seeds and manure.
728. W. P. Wilkins, Ipswich—Arrangements of valves.
729. Sir P. Fairbairn and R. Newton, Leeds—Straightening and separating the fibres of silk waste, and laying them in parallel lengths preparatory to combing or dressing.
731. R. A. Brooman, 166, Fleet-st.—Fire-arms and ordnance.
732. J. Tyssen, Rotterdam—Apparatus for indicating the speed of ships.
733. C. A. Watkins, Greek-st., Soho-sq.—Manufacture of brushes.

Dated 23rd March, 1859.

735. S. Oram, 137, Fleet-st.—Pipes or tubes for generating and superheating steam.
736. W. Adamson, Newcastle-on-Tyne—Apparatus for propelling vessels.
737. S. Clarke, Albany-st., Regent's-park—Manufacture of candles.
738. W. Middleship, Grove-ter., South-grove, Mile-end—Propelling vessels.
739. J. Evans, King's Langley, Hertfordshire—Manufacture of paper.
741. J. V. Hielakker, Brussels—Apparatus for pressing or moulding artificial or patent fuel.
742. G. Neal, Great Charles-st., Birmingham—Apparatus or fittings connected with the burning of gas for regulating and economising its consumption.
743. W. Delany, Norfolk-st., Strand—Ploughs for tilling land.
744. J. H. Johnson, 47, Lincoln's-inn-fields — Apparatus for the manufacture of sheet tin.
745. P. P. Boll and H. Reger, Cologne—Steam boiler and other furnaces.
746. F. Tillett, Banner-st., St. Luke's, Middlesex—Machinery for cutting splints for matches.

Dated 24th March, 1859.

747. W. Garforth and J. Garforth, Dukinfield, Chester—Metallic pistons.
748. W. E. Wiley, 34, Great Hampton-st., Birmingham—Manufacture of boxes or cases used for holding needles.
749. W. E. Wiley, 34, Great Hampton-st., Birmingham—Instruments to be used in burning and supporting candles.
750. F. E. Sharp, 3, Gloucester-ter., Blackheath—Machinery for corking bottles.
751. E. S. Tebbutt—Manufacture of elastic fabrics.
752. C. Sanderson, Sheffield—Preparing, tempering, and covering or coating thin strips or sheets of steel.
753. W. Clark, 53, Chancery-lane—Separating oats from their husks or chaff.

Dated 25th March, 1859.

754. H. Rigby, Salford—Apparatus for obtaining motive power.
755. C. Cowper, 20, Southampton-buildings, Chancery-lane—Telegraphic cables.
756. R. Baker, Liverpool — Chronometers, watches, and other timekeepers.
757. J. H. Johnson, 47, Lincoln's-inn-fields—Fire-arms.
758. W. E. Newton, 66, Chancery-lane—Ovens for baking bread.
759. C. Hill, Chippenham station, Great Western Railway—Improvement in the permanent way of railways.
760. H. Humphreys, sen., Buckingham—Unbairing hides and skins.

Dated 26th March, 1859.

761. G. Hasletine, 37, King-st.—Manufacture of small metallic chains.
763. E. Steane, Manor-rise, Brixton—Apparatus for preventing candles dropping or guttering.
765. M. Firth, Sheffield—Machinery for grinding saws and flat plates of steel.
766. Lieut. G. Naylor, R.M., 7, Durnford-st., East Stonehouse—An apparatus for measuring and indicating the distance passed over or travelled by the same.
767. J. C. Evans and P. Soames, Morden Iron Works, East Greenwich—Apparatus for superheating steam.
768. M. A. Muir, Glasgow, and J. McIlwham—Moulding or shaping metals.
769. E. Dowling, Little Queen-st., Holborn—Weights.
770. B. Smith and C. L. Smith, Corbet's-court, Spitalfields—Preparation of certain coloring matter.
771. J. Buckley, Horwick, Lancashire, O. Greenhalgh, and R. Hutchinson — Apparatus for printing woven fabrics.

Dated 28th March, 1859.

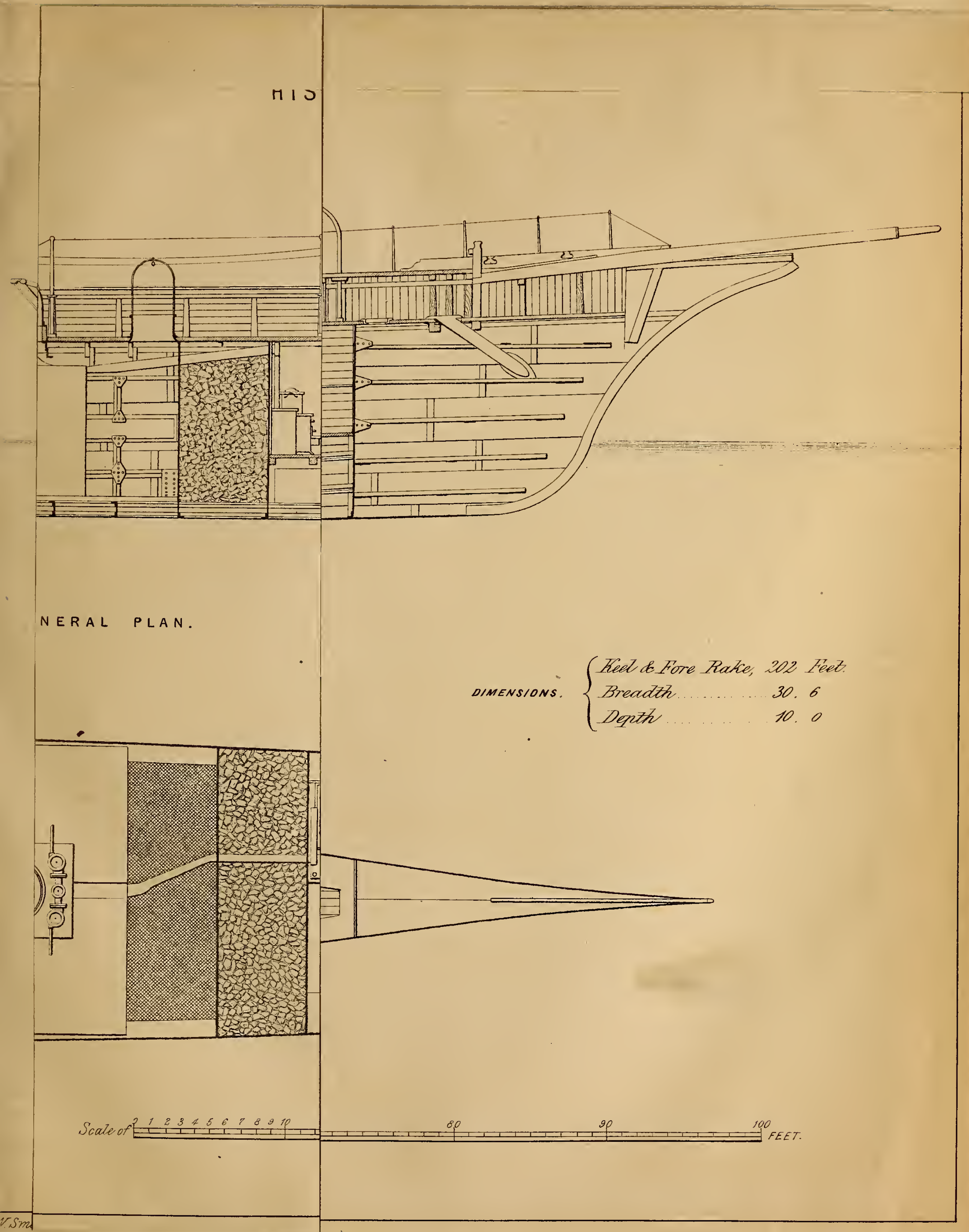
772. C. J. Richardson, 34, Kensington-sq.—Apparatus to be applied to chimnies or flues of buildings, for preventing downdraught or return smoke.
773. C. F. Vasserot, 45, Essex-st., Strand—An improved diving apparatus.
774. J. Buckingham, Westmoreland House, Walworth-common, Surrey—Apparatus employed in drawing fibrous substances.
775. A. V. Newton, 66, Chancery-lane—Furnace for re-heating steel preparatory to the hardening, tempering, or annealing process.
776. A. Turner, Leicester—Manufacture of elastic fabrics.
777. A. V. Newton, 66, Chancery-lane — Apparatus for retaining the oil or other fluid used for annealing, tempering, and bardening steel at an equable low temperature.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

656. G. Seymour, 6, Golden-sq., Regent-st.—Making refined sugar, and potash and soda from the residues.—16th March, 1859.
667. J. Harris, jun., Massachusetts, U.S.—A new and useful or improved carpet-sweeper.—16th Marcb, 1859.
780. W. Mossman, 50, Cumming-st., Pentonville, Clerkenwell—Machinery applied to embossing or cutting presses, for the better and more expeditious manner of manufacturing ornamental out out and embossed work in paper, leather, parchment, cloth, foil, and other materials.—29th March, 1859.
814. F. P. A. Auburtin, 32, Gerard-street, Islington—Preparation of food for herbivorous animals—1st April, 1859.

DESIGNS FOR ARTICLES OF UTILITY.

4157. March 10. Gray and Bailey, Berkley-st., Birmingham—"A Bottle or Roasting Jack."
4158. „ 16. Colin Pullinger, Selsey, near Colchester—"Automaton Mouse and Rat Trap."
4159. „ 26. Brecknell, Turner, and Sons, The Bee Hive, Haymarket, S.W.—"Shade for Candlesticks."
4160. April 4. Moore, Adams, and Peade, 2, Friday-street, Cheapside, E.C.—"Overcoat, to be called the Vienna Wrapper."
4161. „ 5. Parkes and Fell, 10, Upper Hockley-st., Birmingham — "Self-sustaining Ear-rings."
4162. „ 12. Taylor and Elvey, Edingley Southwell,—Notts, "An Improved Drill."
4163. „ 12. Henry Parrich, Birmingham — "A Pin or Skewer."
4164. „ 13. George Jeffries, Golden Ball-st., Norwich—"A Machine for Charging Breech-loading Cartridges."


HIS
NERAL PLAN.
DIMENSIONS. Keel & Fore Rake, 202 Feet.
Breadth 30. 6
Depth 10. 0
Scale of 0 1 2 3 4 5 6 7 8 9 10 80 90 100 FEET.
V. Sm

HIS HIGHNESS IL HAMY PASHA, CONSTANTINOPLE,
BY
Mr J. SCOTT RUSSELL, MILL WALL.

FIG 1. LONGITUDINAL SECTION.

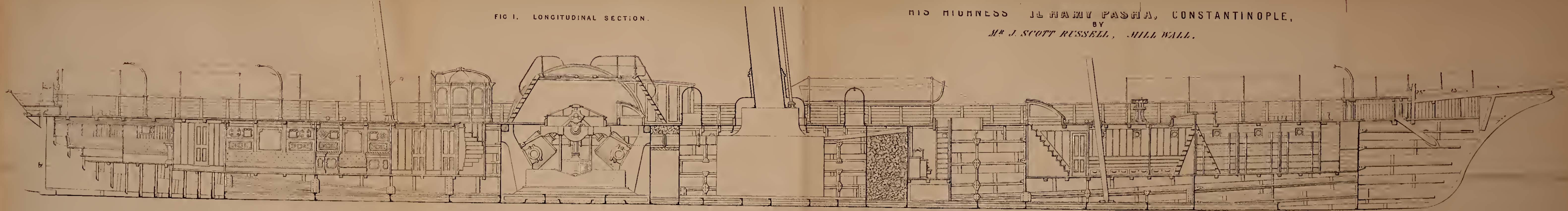
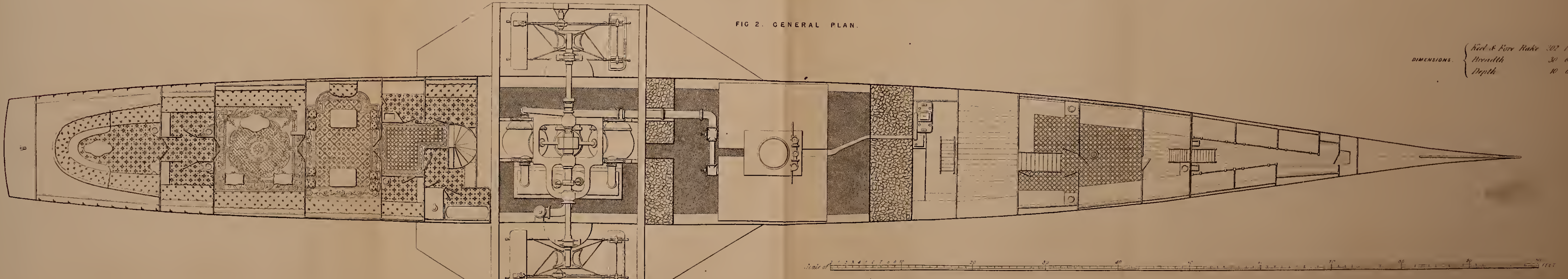


FIG 2. GENERAL PLAN.



DIMENSIONS.

Keel & Fore Rake	202	Feet
Breadth	30	6
Depth	10	0

THE ARTIZAN.

No. 197.—Vol. 17.—JUNE 1st, 1859.

STEAM ENGINEERING IN 1859.

STEAM GENERATION.

In the introductory remarks published in the May Number, our readers will have noticed how carefully any exaggeration has been avoided in speaking of *possible* economics in generating and using steam; and we have taken this course, knowing there are many practical engineers of the present day who do not hesitate to speak of 1½ and even 1 lb. of coal as sufficient to obtain an indicated H.P.; whether such statements will be borne out by any present or future improvements, time will prove. The reason we avoid what may be considered extreme views, is because we wish to stand on firm ground, and have all our statements supported by the general engineering experience of the country.

We propose, therefore, in the spirit of the introductory remarks, to allude simply to facts as they exist, and not to individuals, to attempt to separate the good from the bad, and to point out some of the legitimate improvements that can *always* be realised in the generation of steam, by faith in, and adherence to, the text with which we set out,—that "HEAT IS THE SOURCE OF ALL POWER IN STEAM."

Although the generation of steam or vapour of water has no necessary connection with the machine in which the steam may be afterwards applied to produce motive power, yet it is generally the custom, in considering results, to mix the two together in such a way as to prevent the possibility of arriving at correct conclusions: the diameter of the cylinder is the dimension purchasers look to as the most important, whilst they receive, almost without comment, every variety and size of generator: the consequences of such a practice can be foreseen: the *amount of power* received for a given price varying to the extent of 30 and 40 per cent.

Elaborate and reliable experiments have been made to ascertain the quantity of heat necessary to evaporate a given weight of water, and we receive as ascertained facts the large amount of latent heat in steam and the different quantities of fuel necessary to raise the temperature of a cubic foot of water from 32° to 212°, and to convert it from 212° into steam. We also take it for granted our readers are familiar with the expansive property of steam; if not, we cannot undertake to supply such elementary information.

In steam boilers we have two distinctive features—the fire-grate and the heating or absorbing surface—and they are so closely connected and mutually dependent on each other, that if the relative proportion between them be altered, there is an immediate alteration in the results.

It happens that inexpensive boilers in construction are not necessarily economical in performance; on the contrary, if a small boiler is required to produce a large supply of steam, the result is a considerable waste of fuel; this remark applies to all descriptions of boilers, for land or sea.

If all the heat developed in the combustion of 1 lb. of the best steam coal be utilised, it will evaporate from 14 lbs. to 15 lbs. of water at 212°. How near do we arrive at such a result in ordinary practice?—certainly not within 40 per cent. Ordinary land and marine boilers do not evaporate more than from 7 lbs. to 8½ lbs. of water at 212° per 1 lb. of fuel; in fact, it has been stated on good authority that the average duty of land boilers in the Lancashire districts does not exceed from 6 lbs. to 7 lbs. of water at 212° evaporated by 1 lb. of coal. There are instances of 10 lbs., 11 lbs., and 11½ lbs. of water at 212° being evaporated by 1 lb. of the best fuel; and if the late Newcastle experiments can be relied on, nearly 13 lbs. was evaporated; but this latter duty in an ordinary marine boiler, although with fresh water, is so far above what is realised in general practice, and so *very near* the theoretical value, that we cannot at present admit it in our calculations; it may, however, be conceded that fully 11 lbs. of water at 212° can be evaporated by 1 lb. of good steam coal,—an improvement of more than 30 per cent. on the general practice of the present day.

In generating steam there are two chief sources of waste—radiation, and the heated gases allowed to escape through the chimney. The first can be partly removed by clothing the boiler with non-conducting material; the second is the most important and the most difficult to contend with.

In locomotives the temperature of the escaping gases is upwards of 1,000°; in land boilers, from 400° to 600°; and in marine boilers, from 500° to 900°; in each case depending to a great extent upon the relative proportion between the fire-grate and the absorbing surface, or, more correctly, between the amount of fuel consumed in a given time and the absorbing surface. And this brings us to the real practical difficulty of combining economy of fuel with the development of great evaporating power in a boiler of a given size and weight.

The amount of evaporation in a given time in steam boilers of the same type, is proportional to some extent to the difference between the temperatures of the escaping heated gases and the water to be evaporated with a given absorbing surface: the higher the temperature of the said gases the greater the evaporation in a given time, and the greater the amount of fuel required to evaporate a given quantity of water. On the other hand, the nearer the temperature of the escaping gases approximates to the temperature of the water to be evaporated, the less the evaporation in a given time, and the less the amount of fuel required to evaporate a given quantity of water.

In the above statements it is assumed in each case the boilers are of similar construction and worked under similar circumstances, the only difference being in the ratios of the absorbing surface to the amount of fuel consumed in any given time: the truth of the above is seen every day. In one case (we state actual instances) there is a marine boiler having 1,600 ft. of absorbing surface, and 80 ft. of fire-grate, or a ratio of 20 to 1, the combustion is at the rate of 24 lbs. per square foot of fire-grate per hour, the escaping gases have a temperature of upwards of 800°, 6¼ lbs. of water is raised from 100° to 260°, and evaporated by 1 lb. of fuel, and 190 cubic ft. of water are evaporated per hour, or 1 cubic ft. to 8½ sq. ft. of absorbing surface.

In another instance, we have a marine boiler of similar construction and proportions, except in the ratio of fire-grate to absorbing surface, the latter being 1,200 sq. ft., aud the former 40 sq. ft., or a ratio of 30 to 1. The combustion is at the rate of 16 lbs. per sq. ft. of fire-grate per hour; the escaping gases have a temperature of 450°; 8½ lbs. of water are raised from 100° to 270° and evaporated by 1 lb. of fuel., and 87 cubic ft. of water are evaporated per hour, or 1 cubic ft. to 13¾ sq. ft. of heating surface.

These boilers are working under like circumstances, and, leaving out decimals, the figures given are substantially eorrect, and fully illustrate the connection, previously stated to exist, between the temperature of the waste heat and the duty and economy realised.

If engineers had simply to generate steam with the least possible expenditure of fuel, regardless of time, and the cost, weight, and capacity of the generator, the problem could be solved with comparative ease, but the case is totally different; a eertain weight of steam has to be produced in the least possible time with the least possible cost, weight, and capacity of the generator, and, above all, with the least possible expenditure of fuel—regard being had also to durability and facilities for repair. Here we have the most conflicting conditions, and it cannot be matter of surprise if mistakes have been, and are being made, it being only necessary that one element be over-valued or another be undervalued, to insure an unsatisfactory result. One manufacturing engineer swears by his fire-grate, another by his heating surface, and another by his proportiou or form of flues; it matters not which is the favourite view (one may be adopted with less injury to the purchaser than another); nothing short of an impartial consideration of each and *all* of the requirements in generating steam can meet the difficulties of the case.

If such impartial consideration was the general rule, there would be no occasion for the present remarks.

The history of the locomotive boiler clearly shows how little previous design has had to do with its present efficiency; the necessity of using high pressure steam, and the difficulty of condensing, led the way to the blast; and it must be admitted that, of all kinds of boilers, the locomotive is the most scientifie and the most economical, if allowance be made for the peculiar requirements connected with its use.

Notwithstanding the temperature of the smoke-box is often 1,000°, with a combustion of from 60 to 120 lbs. of fuel per square foot of fire-grate per hour, a larger amount of water is evaporated by a given weight of fuel than in the majority of land or marine boilers. The rapid combustion is more perfect—almost every portion of the boiler is protected by non-conducting materials—less than 7 ft. of heating surface is sufficient to evaporate a cubic foot of water—and 1 lb. of Welsh coal will evaporate 8½ to 9 lbs. of water: nevertheless, there is much unnecessary waste of fuel in the high temperature of the escaping gases (although they are not, *comparatively*, so high when the temperature in the furnace is considered), and in supplying the feed-water at a low temperature. With the introduction of coal as fuel, modifications may be required in the furnace and tubes; and there is much reason to believe, from eomparative experiments, that *crowded* tubes do not allow the steam to escape to the steam space as quickly as it is generated.

We may confidently look to a considerable increase of economy and efficiency in the locomotive boiler, even though now for weight, space, cost, and economy of fuel, it must be placed at the top of the list, and certainly deserves the least criticism.

The duty and economy of steam boilers are mainly dependent on the rate of combustion, the ratio between the heating surface and the fire-grate, and the ratio between the heating surface and the consumption of fuel per hour, thus:—

Rate of Combustion.

Cornish boilers burn per square foot of fire-grate	4 lbs.
Ordinary land boilers	12 „
Marine boilers	18 „
Locomotive ditto	100 „

Ratio between Heating Surface and Fire-grate.

Ordiuary land boilers	12 to 1
Marine boilers	27 to 1
Cornish ditto	36 to 1
Locomotive ditto	75 to 1

Ratio of Heating Surface to Rate of Combustion.

Cornish boilers	9·0 to 1
Marine ditto	1·5 to 1
Ordinary land ditto	1·0 to 1
Locomotive ditto	0·75 to 1

The preceding figures are only approximate, but they represent the particular features of each elass, and if we were to tabulate them according to the *economy* generally realised, the Cornish boiler would stand first, the marine second, and the common land boiler third; for obvious reasons, the locomotive boiler cannot be fairly classed with the other three.

If we take as a standard the *rate of evaporation* for a given quantity of heating surface, we must place the common land boiler first, the marine boiler secoud, and the Cornish boiler third; and here again the locomotive boiler must be omitted as an exceptional construction.

In such general remarks and statements as the preceding, it is not necessary that they should represent the experience of all our readers—they are based on actual practice, and suffice to illustrate the subject under discussion, and point out the connection always existing between sound principles aud successful practical engineering.

It is assumed, as generally acknowledged, that from 30 to 60 per cent. of fuel is wasted in generating steam, and that a considerable amount of this waste ought to be, and can be, avoided; and although we do not dictate the exact means for accomplishing this, we can easily trace out, in the majority of eases, the direction of the improvemeut required.

Boilers made and used in districts where fuel is cheaply obtained have never been remarkable for their economical performances, uor are the engineers in those districts famed for great anxiety to introduce improvements for economising fuel; it cannot be expected, and we are not surprised to know that land boilers in coal districts only evaporate 6 lbs. of water at 212° by one pound of fuel.

With waggon or plain cylindrical boilers, that form such a large proportion of those now iu use on land, economy of fuel is simply a question of size to produce a given weight of steam, it becomes almost entirely a question of capital; an increased ratio between the heating surface and the fire-grate is in this case the desideratum; the furnace flues and chimney being well-proportioned, and every effort made to check radiation.

In the Cornish boiler, where the furnace is *within* the inside tube or tubes, that temperature in combustion which is so essential to its perfection is not easily obtained; hence the difficulty that arises in attempts to consume the smoke in such furnaces; an increase of duty and economy would ensue from placing the furnace *under* the boiler, and returning the heated gases through two smaller tubes—a plan that has been often tried with universal success; it allows ample space in the furnace, insures perfect combustion, and has also other mechanical advantages.

In other descriptions of land boilers, where additional heating surface is introduced within the main shell, if well proportioned, they are generally more economical than the Cornish boilers with the same ratio of heating surface to fire-grate, and with the same rate of combustion.

There can be no doubt that, for land purposes, a boiler with internal flues, capacious furnace, a greatly inereased ratio between the heating surface and the fire-grate, and a rate of combustion above that in general practice, is the cheapest, the most effective, and the most economical.

There can be — indeed there is — no difficulty with such boilers in realising an increased economy to the extent of 30 per cent., and in obtaining a greater effect in a given time from a ton weight of boiler.

We must defer to next month our investigation of the present state and future prospects of steam generation in marine boilers—the most important branch of our subject. If there are reasons why we should economise fuel on shore, how much stronger do they become when it is a question of freight as well as of fuel saved.

In addition to the purely economical value of steam boilers, we shall hereafter have to consider their mechanical construction, especially as affected by the introduction of steam of high pressure.

In concluding these remarks, we would impress on our readers that our only wish is to direct attention generally to present defects in the Steam Engineering of 1859, and to point out to young engineers those paths of improvement where their energies and talents will be productive of real benefit to their profession, and to the world at large.

THE "CLEOPATRA" STEAM YACHT.

(Illustrated by Plate No. 147.)

ON reference to THE ARTIZAN for January last (page 9) will be found some particulars respecting this steam yacht, the property of Il Hamy Pasha; and we have now the pleasure of presenting to our subscribers a large Copper-plate Engraving, exhibiting two longitudinal views of the ship and her machinery, drawn by John Maxton, and engraved by J. W. Lowry.

Upon the present occasion we regret we cannot do more than refer our readers to the former notice of this ship and her performance when on trial in the Thames, and add, that during the time she has been running upon the station assigned to her, she has given unqualified satisfaction to her noble owner, maintaining her character as a fast ship, and the same state of efficiency of machinery and coal economy which were claimed for her when under trial on the Thames.

Capt. E. Johnson, in reporting upon the performance of the *Cleopatra*, states—"We started from the Golden Horn at 11·30 A.M., and she went off in beautiful style; there was no perceptible vibration, and a total absence of the large wave which followed her in the shallow waters of the Thames. The minimum depth of the Bosphorus is about 30 fathoms; but I kept in the centre of the stream so as not to be influenced by the current. Time was noted by his Highness, and by all the gentlemen present, when abreast of the Golden Horn. We went up the Bosphorus as far as Karrava Fort, on the Asiatic side, then turned round, still going at full speed. The vessel did not heel over in the slightest degree; and the party, who were all seated under the awning, spread for the occasion, were not aware of the manœuvre until feeling the wind and rain beating in their faces. We then steamed into Bukedyre, and anchored close to the town; the whole time occupied in performing this distance being 40 minutes.

"At 3 o'clock the anchor was weighed, and we proceeded to the harbour of Constantinople, which we reached at 3·20. The average speed obtained during these runs being rather more than 16 *knots* per hour. Her draft at starting, with 35 tons of coal on board, was 4 ft. 7 in. fore and aft, being on even keel."

Captain Johnson reports most favourably of the performance of the engines and machinery, as well as the coal economy, and states the unqualified approbation expressed by His Highness Il Hamy Pasha, as well as the various naval officers and other qualified persons who have witnessed the performances of the *Cleopatra*; and we have much pleasure in thus recording another triumphant success achieved by Mr. J. Scott Russell.

ASSOCIATION OF FOREMEN ENGINEERS.

THE meeting of Foremen Engineers, held at the "Bay Tree Assembly Rooms," City, on Saturday, the 5th ult., Mr. John Briggs—of the firm of Tyler and Co., Whitecross Street, London—read a Paper ON THE CONCUSSION OF WATER; Mr. Joseph Newton, of the Royal Mint, presided on the occasion, and a numerous auditory attested to the interest excited on the subject to be considered. After the election of sundry new members, honorary and ordinary, the Chairman invited Mr. Briggs to redeem his promise. He commenced his Paper by enumerating the difficulties that are inevitably met by hydrostatic engineers in the successful construction and application of mechanical contrivances for the lifting and forcing of water through pipes. Few practical mechanics, he said, were unacquainted with the effects of the concussion of water in pipes; and, indeed, on a smaller scale, they were known also to householders and others; the means of preventing the jarring and disagreeable noises, however, were not so well understood. Frequently in works of an extensive nature, more than inconvenience resulted from concussion; the stability of buildings in which pumping engines were placed was interfered with to a very serious extent, whilst the bursting of pipes entailed damage, and consequent expense, which made the question of preventive or remedial measures a subject of vital consideration. Sometimes such untoward phenomena exhibited themselves in suction pipes, at others in the delivery or rising main. When water supplies were drawn from reservoirs constructed on high places, or from the high-pressure mains of waterworks, the evil had been experienced to an enormous extent. It did not signify whether the pipes ran horizontally, obliquely, or vertically; the same effects were produced when the water passing through them attained a certain velocity, and was from any cause suddenly checked by sluices or stop valves. Perhaps this latter might be deemed the primary cause of the concussion in the cases of waterworks, or high level reservoirs.

Few, if any, scientific works, said Mr. Briggs, treat upon this important matter; and the man of practice, therefore, in this instance at least, derived little information from the man of theory. He next proceeded to give some account of his own personal experiences of the difficulties and dangers of concussion; many of his extracts being of a most interesting and instructive kind. With respect to the general means for avoiding or removing the causes of the inconvenience, the introduction of air or vacuum chambers to the delivery or suction pipes was first spoken of as being of the greatest service. Screw valves, for the gradual arrest of the flow of waters at high velocities, were also adverted to, and some water cranes on the North Western Railway works were instanced as illustrative of the value of these appliances.

The general conclusions, however, come to, after an elaborate dissertation on the whole subject was, that when water has to flow through large pipes with considerable velocity, the application of screw-valves is indispensable, for the avoidance of concussion. That when it has to flow through smaller pipes, the introduction of air vessels will have the desired effect, whether the water descends from tanks or reservoirs, or is forced forwards by means of pumps. And that whenever concussion exists in the suction pipes of pumps, the introduction of vessels or pipes to be partially exhausted — and hence may be named vacuum chambers, attached as nearly to the working barrels as convenient—will prove the most efficient, if not the only remedy. The philosophical and mechanical action of these various appliances, and the best form of valves for pumps of each kind, occupied the attention of the meeting after the conclusion of the Paper; and an animated discussion, wherein Messrs. Keyte, Strabler, Jones, Ferguson, the Chairman, and others took part, brought too speedily 11 o'clock, and an adjournment of the "debate" until the night of the first Saturday in June. Mr. Newton declared the sitting at an end, and the members shortly after retired.

THE ROYAL NATIONAL LIFE-BOAT INSTITUTION.

(Illustrated).

THE LIFE-BOAT, DESIGNED BY JAMES PEAKE, ESQ., Master Shipwright in Her Majesty's Dockyard, Devonport.

THE accompanying figures show the general form, the nature of the fittings, and air-chambers of one of these boats, 30 ft. in length and 7 ft. 6 in. in breadth. In Figs. 1 and 2, the elevation and deck plans, the general exterior form of the boat is shown with the sheer of gunwale, length of keel, and rake or slope of stem and stern-posts. The dotted lines of Fig. 1 show the position and dimensions of the air-chambers within board, and of the relieving-tubes. In Fig. 2, A represents the deck, B the relieving-tubes (6 in. in diameter), C the side air-cases, D the end air-chambers. In Fig. 3, the exterior form of transverse sections, at different distances from stem to stern, is shown. Fig. 4 represents a midship transverse section, A being sections of the side air-cases, B the relieving-tubes, bored through solid massive chocks of wood of the same depth as the space between the deck and the boat's floor. C, C, are spaces beneath the deck, filled up, over 6 ft. in length, at the midship part of the boat, with solid chocks of light wood, forming a portion of the ballast; *d* is a section of a small draining-tier, having a pump in it, by which any leakage can be pumped out by one of the crew whilst afloat. The festooned lines in Fig. 1 represent exterior life-lines attached round the entire length of the boat, to which persons in the water may cling till they can be got into the boat; the two central lines are festooned lower than the others, to be used as stirrups, so that a person in the water by stepping on them may climb into the boat.

This life-boat possesses, in the highest degree, all the qualities which it is desirable that a life-boat should possess :—

1. Great lateral stability.
2. Speed against a heavy sea.
3. Facility for launching and for taking the shore.
4. Immediate self-discharge of any water breaking into her.
5. The important advantage of self-righting if upset.
6. Strength.
7. Stowage-room for a number of passengers.

TRANSPORTING-CARRIAGE, DESIGNED BY CAPT. A. WARDE, R.N.,
Inspector of Life-boats to the Institution.

The carriage consists of a fore and main body. The latter is formed of a keelway, A A, and of side or bilgeways, B B, in rear of the main axle—the boat's weight being entirely on the rollers of the keelway. Its leading characteristic is that, on the withdrawal of the long forelock pin C, the fore and main bodies can be detached from each other. The advantages of this arrangement are, that the weight of the boat when she is launched from the rear end forms an inclined plane by elevating the keelway, yet without lifting the fore body off the ground; whilst to replace her on the carriage, she can be hauled bow foremost up the fore end or longer incline. The bilgeways, B B, are needed at the rear end, that the boat may be launched in an upright position with her crew on board; but they are not required at the fore end of the carriage. The boat is hauled off the carriage and launched into the sea by a rope on each side of the boat rove through the sheeve, D, having one end hooked to a self-detaching hook at the boat's stern, and the other manned by a few persons on the shore, who thus haul the boat and her crew off the carriage and launch them afloat at once, with their oars in their hands, by which means headway may be obtained before the breakers have time to beat the boat broadside on to the beach.

OF THE INSTITUTION.
A few Remarks on its Origin and its Present Condition.

Of late years the subject of life-boats has attracted considerable attention from the circumstance of the increasing numbers of wrecks, consequent on the rocky nature of our shore, and the vast and increasing amount of our commerce. The exertions, too, of the National Life-boat Institution have had a powerful influence in directing attention to this subject.

To a nation so devoted to maritime enterprise—so maritime in its tastes and sympathies, with such an extent of ocean-beaten coast—with a people that link all their glories with the sea;—to England, in a word, everything that concerns the mariner, that can aid him in his perilous toil, or when he struggles with the fury of "the restless, seething, stormy waves," must naturally possess a peculiar interest. Two-thirds of our population are more or less connected with the sea, and their interests are more or less affected by the results of our maritime enterprise; so that we find in one year (1858) no less than seventy wrecks occurred upon our coast, with the loss of three hundred and forty-three persons. These fearful calamities have taken place on the coasts of the most busy maritime island in the world, where, if there be liability of disaster through the vast congregation of shipping, there ought, on the other hand, to be a supply of invention and good sense sufficient to check, in some degree, such disasters.

A few years ago a lamentable accident occurred to a South Shields life-boat, whereby twenty pilots were drowned. This induced the Duke of Northumberland to offer a reward for the best model of a life-boat. This offer was responded to by boat-builders and others from various parts of the kingdom, as well as from France, Holland, Germany, and America; so that two hundred and eighty models and plans were sent in. About fifty of the best of these were exhibited by his Grace in the Great Exhibition of 1851. He also caused a report to be prepared, accompanied by plans and drawings, with a view to elicit the best form of life-boat; for although the prize of £100 was assigned to Mr. Beeching, of Great Yarmouth, it was considered that a better boat might still be produced. Accordingly, Mr. James Peake, Assistant Master Shipwright in H.M. Dockyard at Woolwich, was requested to furnish a design for a life-boat which might combine as many as possible of the advantages, and have as few as possible of the defects of the best models examined by the committee. A boat was accordingly designed by Mr. Peake, in Woolwich Dockyard. Some modifications were, from time to time made in her, in consequence of various experiments, and a trial of her capabilities made in a gale of wind at Brighton.

In the course of the winter several life-boats on this model were taken afloat on trial by the Life-Boat Society's Inspector, Captain Ward, R.N., some of them in heavy seas and gales of wind, and the result of the trials was considered to be highly satisfactory. Other boats were built on the same plan, and we may therefore consider this as the model life-boat. These boats have been for the most part of two sizes, viz., 27 and 30 ft. in length, with 7½ to 8 ft. beam, and rowing from eight to twelve oars double-banked; their weight averaging two tons. But as such boats have been found too heavy to be managed in some localities where boatmen are few, boats of less beam and weight, rowing six oars single-banked, but on the same design in other respects, have been built, under the denomination of small life-boats. The former class of boats have also been somewhat modified and lengthened since the description of the boat was first published, so as to be reduced somewhat in beam, and to have less height and greater sharpness of the bow and stern, to enable them to be rowed with greater speed against a head gale and a heavy sea. They are also built of fir, upon the diagonal principle of double-planking without timbers, whereas the earlier boats were of elm, and clenched, or clinker-built.

The Royal National Life-Boat Institution has been organised for the purpose

PEAKE'S LIFE-BOAT.

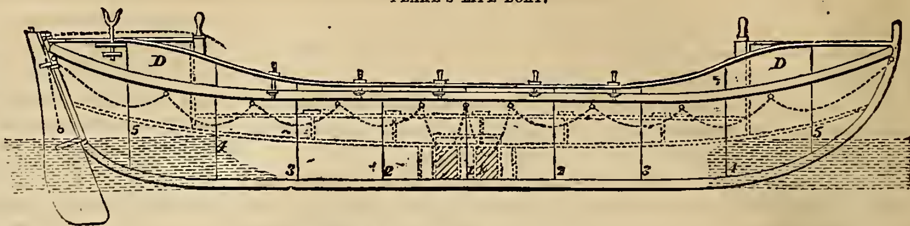


Fig. 1.—Sectional Elevation.

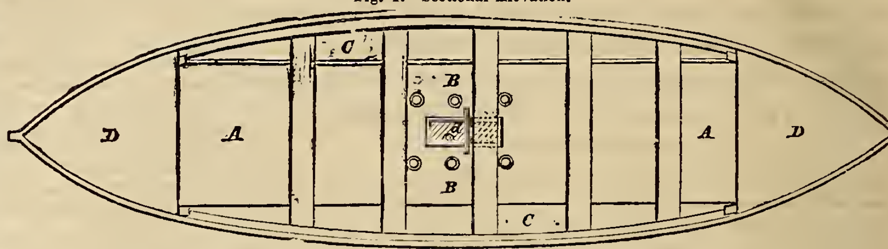


Fig. 2.—Deck Plan.

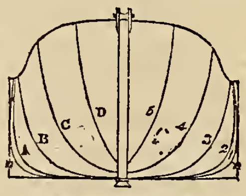


Fig. 3.—Body Plan.

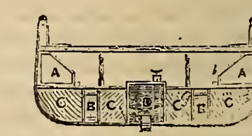
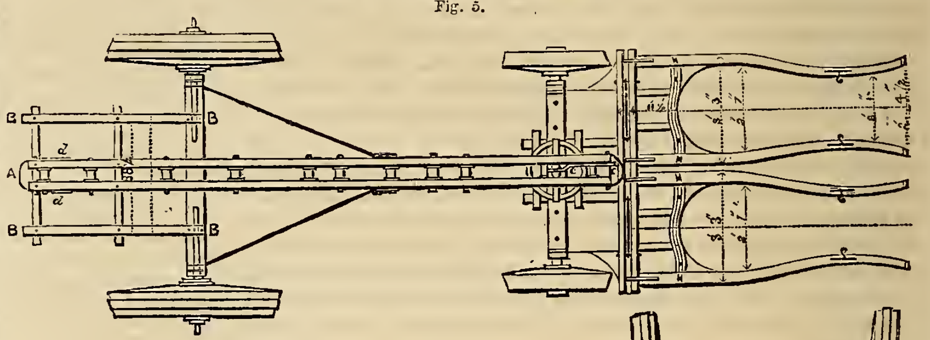


Fig. 4.—Midship Section.

LIFE-BOAT TRANSPORTING CARRIAGE.

Fig. 5.



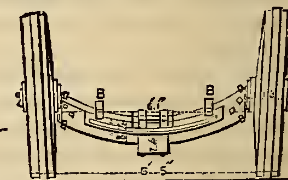


Fig. 7.

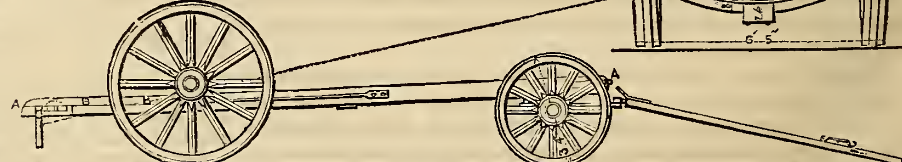


Fig. 6.

of lessening the great evil of a want of sufficient means to save life in the case of shipwreck, and its usefulness cannot be over estimated. This Institution has still in use in some localities life-boats from the designs of various parties; but all life-boats now constructed by it are in Mr. Peake's plan. The average cost of these boats, with their various fittings and gear, and life-belts for their crews, is about £160 each. The life-boat's transporting carriages cost from £80 to £160, and the boat-houses from £50 to £100. It will be thus seen that a complete life-boat establishment will cost about £400.

In addition, there must be a crew of trusty men, able and willing to brave a raging sea, strong and resolute to pull the oar under any stress of weather, and there must be a master and coxswain, exercising sufficient control to command the men, and direct their energies in a proper channel. It is in this direction, quite as much as in the provision of life-boats, that the Life-Boat Institution has rendered good and efficient service. A system of payment, partly in the nature of a salary, and partly as a reward, is adopted, such as may induce steady men to render aid; and honorary local committees assist in collecting the means whereby the outlay is to be defrayed, and in the general management of the life-boat establishment.

This Institution now numbers eighty-one life-boats in connection with it. To maintain these boats in a state of thorough efficiency requires a large permanent outlay. Last year the life-boats of the Society, and those of local bodies, rescued 206 persons from shipwreck on our coasts; and during the last three years 967 persons were by the same invaluable means rescued from a watery grave. On the other hand it is lamentable to add, that during the same short period, 343 poor creatures perished on our coasts from these sad disasters. It is believed that a considerable proportion of this large number might have been preserved to their families and their country if additional life-boats were on the coast.

In the event of fatal accidents happening to the crews of its life-boats, or to those of shore-boats, while attempting to rescue shipwrecked persons, the Institution votes gratuities, varying from £5 to £50, to widows and other dependents. Thus the Institution holds out every inducement, as far as the means placed at its disposal by the public admit, to parties to exert themselves to save life from shipwreck. The total number of persons saved from shipwreck since the first establishment of the Royal National Life-boat Institution, by its life-boats and other means, and for rescuing whom the committee had granted honorary and pecuniary rewards, is 10,902! The operations of the Institution may be thus briefly stated:—Since its establishment it has expended upwards of £29,000 on life-boats and their appurtenances, and has voted 81 gold medallions and 629 silver medals for distinguished services for saving life, besides pecuniary rewards, amounting to £11,651.

And yet, from the last annual report of the Society, we find that its expenditure in providing new life-boats, maintaining life-boat stations, and in granting rewards and medals, exceeded its income by £2,586, while between sixty and seventy additional new life-boats are reported by official persons to be needed on the coasts. As so valuable an Institution appears by the foregoing statement to be in want of funds, surely England will not fail to render it effectual aid, as it possesses so many claims upon the country's liberality. We therefore confidently believe that, when its appeal for help is thoroughly known, it will be liberally responded to.

In conclusion, we have to observe that in looking through the list of subscribers to this National Institution, we are as much astonished as grieved to note the almost total absence of representatives of the great commercial firms of this country, who to their shame and disgrace be it written, the entire sum contributed by the commercial marine of this great maritime country amounts to but a very few pounds; indeed, so very few, that we, out of sheer consideration for their characters, refrain from publishing it.

THE PACIFIC STEAM NAVIGATION COMPANY'S PADDLE-WHEEL STEAM-SHIP "LIMA."

AT the last meeting of the British Association, Mr. John Elder, of the firm of Randolph, Elder and Co., Engineers, Glasgow, read a very interesting Paper on "Double Cylinder Expansion Marine Engines," a report of which Paper will be found on reference to THE ARTIZAN for January, 1859, p. 10. In that Paper Mr. Elder described the engines supplied to the *Valparaiso*, a paddle-wheel steam-ship, belonging to the Pacific Steam Navigation Company; the vessels composing their fleet being employed in carrying mails and passengers between Valparaiso and Panama, along the Pacific coast. The engines of the *Valparaiso* consisted of two large cylinders, each 90 in. diameter; and two small cylinders, each 52 in. diameter; one large and one small cylinder being set diagonally opposite, in the same longitudinal line—their piston-rods being connected to the same crank-pin. The two cranks, instead of being set at right angles, are set opposite to each other, the air-pumps being worked each by a large eccentric. We cannot now stop to describe in detail the arrangement of these engines, more especially as we have in preparation copper-plate engravings of them, which will appear next month.

Our present purpose is to notice the performance of the machinery of the *Lima*, a sister-ship of the *Valparaiso*, during a trial-trip—which, instead of being over a measured mile, and admitting of the usual amount of *jockeying*, in deference to the published opinions of the Steam-ship Performance Committee, and for the satisfaction of the owners, was made between Liverpool and Kingstown Harbour and back; the measured distances between the starting points (the Rock Light and Kingstown Harbour) were taken, for the purpose of exact experiments; and the following particulars of the run out and home, taken together, with the return of particulars respecting the *Lima*, whilst under trial, will afford highly satisfactory data, for the accuracy of which we can vouch. We regret, however, that there are some particulars respecting the actual measurements of the ship, and some other details, which we had not the means of obtaining.

It is perhaps necessary to state that the *Lima*, like the *Valparaiso*, is not a new ship, but was built upwards of seven years ago. In consequence of the coal economy effected by Messrs. Randolph, Elder and Co. in their arrangement of engines and boilers, the Directors of the Pacific Steam Company ordered these vessels home, had their engines and machinery taken out, and, in the case of the *Valparaiso*, the consumption of coal was reduced from 5½ or 6 lbs. to 2½ lbs in actual ocean performance; and as the cost of coal is so great in the Pacific, the importance of this economy made itself apparent to the owners of the Pacific line, and one after another the vessels composing their fleet are being fitted by Messrs. Randolph, Elder and Co.

The following is extracted from the log:—

Steam-ship "LIMA'S" run from Liverpool to Kingstown and back.

Liverpool to Kingstown. Left Liverpool May 18th, 1859.			*Kingstown to Liverpool.* Left Kingstown May 20th, 1859.		
Where off.	Time.	Distance	Where off.	Time.	Distance
	h. m.	Miles.		h. m.	Miles.
Rock lighthouse.	1 22 p.m.		Kingstown......	2 45 a.m.	
to Crosby light ship	1 42 p.m.	4	to Kish light	3 13 a.m.	7¼
to Formby	1 52 p.m.	3	to Holyhead	6 45 a.m.	43½
to Bell Buoy	2 2 p.m.	3½	to Skerries	7 30 a.m.	7½
to Point Lynas	4 48 p.m.	36	to Point Lynas	8 25 a.m.	11½
to Skerries	5 47 p.m.	11½	to N.W. light ship .	11 4 a.m.	35
to Holyhead	6 6 p.m.	7½	to Rock lighthouse.	11 47 a.m.	10
to Kingstown Harbour	10 15 p.m.	50¾			
Total	8 53	116¼	Total	9 2	114¾
Draught of water:— Fore ..11 ft. 0 in. | Aft....12 ft. 0 in.			Draught of water:— Fore..10 ft. 11 in. | Aft. ..11 ft. 11 in.		

The following is the return, &c., respecting the steamship *Lima*, when under trial:—

Performance under Trial.—Date and place of trial, May 18th and 20th, from Liverpool to Kingstown and back. Force and direction of wind, tide, and sea, fresh breeze, northerly. Consumption of coal in getting up steam, 3 tons. Ditto, during the trial out and home, 20 tons 14 cwt., mixed Welsh, Newcastle, and Clyde. Average indicated H.P., 1,150. Average speeds of runs according to Admiralty practice, in knots, 12.

Actual Measurements of Ship.—Drafts of water on trial: out, forward, 11 ft.; aft, 12 ft.; home, 10 ft. 11 in. forward, and aft, 11 ft. 10 in.

Propellers (Paddle-wheel).—Diameter, length, breadth, and thickness of floats, 8 ft. 2 in. long, 3 ft. broad, ¾ in. thick, 26 ft. over all, 25 ft. 2 in. over floats. What sort, feathering. Weight of each wheel, 20 tons. Depth of immersion on trial, 4 ft.

Engines.—Kind or description of engine, Randolph, Elder, and Co.'s patent double cylinder. Dimensions of cylinders, two 90 in. low-pressure, and two 52 in. high-pressure. If steam-jacketed: yes, tops, bottoms, and sides. Number of cylinders, four. Kind of condenser and cubic contents, common, 400 cubic ft. Ditto of air-pump and cubic contents, common, and each 17 cubic ft. Description of valves and areas of passages, short slides, 24 in. by 6 in. Total weight of engine, 200 tons. Speed of piston in feet per minute, or number of revolutions per minute, 240 ft., at twenty-four revolutions. Temperature of feed-water, 100° Fahr. Nominal H.P. according to maker's contract, 320 H.P. Indicated H.P. at time of trial, with diagrams taken simultaneously at the top and bottom of cylinders, average 1,150. The pressure of steam in the boiler, 24 lbs. The vacuum in condenser, 28 in.

Boilers.—Number of boilers (or pieces), 2. Description of boilers, tubular; steam superheated to 400° Fahr. Dimensions of ditto, 12 ft. by 10 ft.; width, 288 4-in. tubes. Total weight of boilers with and without water, 68 tons with water, 50 tons without water. Dimensions of steam-room and water-room in cubic feet, 1,000 cubic feet. Number of furnaces, 6. Dimension of grate surface, tube surface, and other heating surface, grate 136, steam 1,700, heating, including uptakes, 1·500. Cubic contents of combustion-chamber and furnaces, 480. Distance of fire-bars from top of furnace, 2 ft. Ditto of bars from top of ash-pit, 2 ft. 6 in. Actual air-space through fire-bars, about 50 ft. Number, length, internal and external diameter and material of tubes, 288 iron tubes, 4 in. diameter inside, $4\frac{1}{4}$ outside, 6 ft. 6 in. long. Number and dimensions of chimneys, one 5 ft. diameter. Load on safety-valve, to blow off at 27 lbs. Consumption of coal per hour, 23 to 24 cwt. Total consumption during 18 hours, 20 tons 14 cwt. net.

The following are the dimensions of the vessel:—

"Lima."

	Ft.	
Length on deck	257	0
,, between perpendiculars	251	0
Breadth extreme	30	0
Depth of hold	17	0
,, to spar deck	25	4
Length of engine-space	71	0
	Tons.	
Tonnage O. M.	$1115\frac{44}{94}$	
Gross	1461·24	
Engine-room	295·61	
Register	1165·63	

Actual length of engine and boiler space = 38·9 ft. This does not include space occupied by coal bunkers.

The weight of the steamship *Lima* on her trial was 1,345 tons, and the immersed midship section gave an area, as near as we could calculate, of 302 ft.

The performance of the engines during the trial was generally highly satisfactory; a hot bearing or two during the run out gave a few minutes' trouble, and the want of attention to the feed allowed the water in the boilers to fall too low; but, notwithstanding these causes of delay, although slight, we refer to the above particulars of the performance of the *Lima*, under a lengthened experimental trial, as the most satisfactory practical performance yet attained in the commercial steam marine of this or any other country, and it affords us great pleasure, whilst recording the great success achieved by Messrs. Randolph, Elder and Co., to point to the highly creditable and enlightened policy of the Directors of the Pacific Steam Navigation Company, for having given encouragement to the enterprise, and practical skill and ability of the engineering firm to whom they have most judiciously entrusted the construction of the engines and machinery for more economically propelling their ships.

In thus encouraging practical economical improvements in the employment of steam in the marine-engine, they are setting an example to other great steamship companies, to the owners of sea-going steamships, and also to that department of the Government charged with the construction, management, and maintenance of the British Navy; and which example, we trust, will not be lost upon them.

We believe that, with the addition of a judicious arrangement of surface condenser, instead of the present arrangement of injection condenser, as fitted on board the *Lima*, and the introduction of one or two minor alterations, the coal consumption in actual service may be reduced to 2 lbs. of best fresh coals per indicated H.P. per hour; and, as Messrs. Randolph, Elder and Co. have thus far succeeded so admirably—in a manner so highly creditable to themselves as engineers—they will not stop here and rest content with their present achievement; but we trust that the opportunity will very soon be afforded to them of continuing and applying the result of their further experience in marine steam economy.

In the arrangement of the engines, machinery, and boilers of the *Lima*, there is much that deserves attention and commendation; but we must defer until next month any further or more detailed notice.

IRON STEAM FRIGATES OR RAMS.

On reference to "Notes and Novelties," page 158, in the present number, some particulars will be found relative to the huge iron-coated steam frigates or rams about to be built for the Royal Navy. The Thames Iron Works and Shipbuilding Company having received orders to build one of these monster vessels, the tonnage of which will be about 6,000 tons, to be coated with armour-plates for sides and deck, $4\frac{1}{2}$ in. in thickness for a portion of the length of midships only; the total weight of these plates will be about 1,000 tons. Experiments are about to be made to ascertain the relative values of hard hammered, and annealed iron plates as compared with rolled plates of the same thickness; these experiments are, we believe, shortly to be made in Portsmouth Harbour.

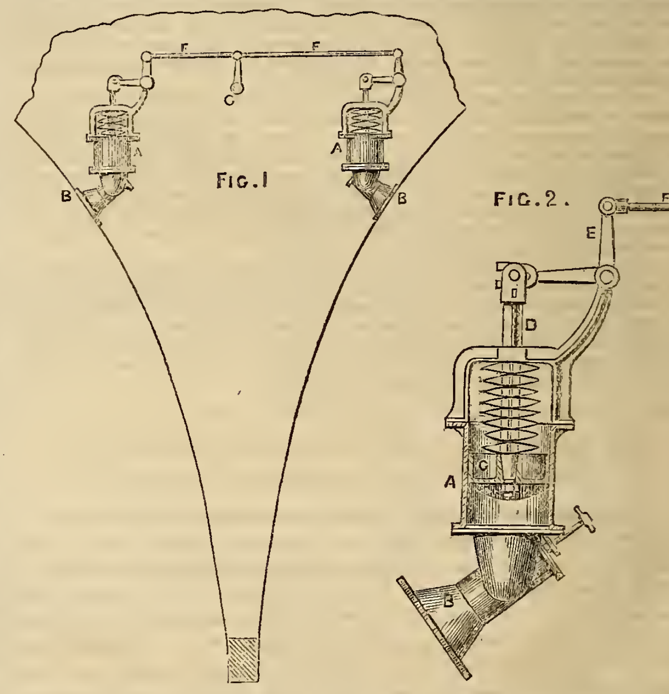
A peculiarity in the form and construction of these ships is, that whilst to all outward appearance, when they are finished, they will present very much the usual appearance of the frigate-class of ship, the rams or top sides, above light load-line, will "tumble home" very considerably, or be several feet less in width than the breadth at light load-line. This hollowing inward of the sides is for the purpose of cross planking the external sides with two thicknesses of teak, or one thickness of teak overlaying a thickness of oak, together, we understand, about 18 in. thick; over these the armour-plates will be fixed, whilst on the inside a lining of 18 in. or 2 ft. thick of soft English wood, not liable to splinter, will be placed; thus offering a wall of considerable thickness, and varying in degrees of hardness, and ability to check the action of shot or shell projected against the armour-plates.

Messrs. John Penn and Son have received from the Admiralty the orders for the engines and machinery for propelling this monster war ship.

JENSEN'S MARINE-ENGINE GOVERNOR.

(Illustrated with Woodcuts.)

At the Institution of Mechanical Engineers, on Wednesday, the 4th of May, a Paper was read, by Mr. Henry Maudslay, descriptive of this apparatus; the object of which is to prevent the engine from running off at an excessive speed, when the resistance of the water to the propeller is suddenly removed by the pitching or rolling motion of the vessel in stormy weather. This governor consists of a cylinder, A, at the bottom of which a communication, or opening, B, is made through the side of the vessel, as near as possible to the propeller



or paddle-wheel; in this cylinder a piston, C, works, attached to the piston rod, D, which is connected by means of bell-cranks, E, and rods, F, with the spanner or lever-arm, G, of the throttle-valve in the steam-pipe of the engine. When the motion of the vessel causes the propeller to be less deeply immersed, the pressure of water in the cylinder, A, is diminished, the piston, C, of which is forced down by the spring above, thereby closing the throttle-valve to the required extent, and preventing the speed of the engine from increasing; also, when the propeller is more deeply immersed, the pressure in the cylinder, A, is increased, and raises the piston, C, opening the throttle-valve, and admitting more steam to the engine, so as to maintain the required speed: the object being to control the speed of the engine before it has time to sensibly change, instead of waiting for a change to bring the governor into action. Fig. 1 is a view of the apparatus as applied to a vessel; the apparatus is shown in Fig. 2 detached and to an enlarged scale.

ON THE RELATIVE VALUES OF COKE AND COAL IN LOMOTIVE ENGINES.*

By Benjamin Fothergill.

Having attended a meeting in the Society's rooms on 2nd December, 1857, and taken part in the discussion relating to the use of coke and coal in the furnaces of steam-engine boilers, I then undertook to lay before its members the results of a series of experiments which I had made with coke and coal in locomotive engines in corroboration of the truth of my assertions:—

First. That coal was decidedly superior to coke in respect to heating power, and consequently more economical;

Second. That a plentiful supply of steam could be generated by the use of coal for working engines at high velocities, and for drawing heavy trains;

Third. The capabilities of coal-burning engines for consuming their own smoke; and

Fourth. The increased durability of fire-boxes and tubes when coal was used.

On that occasion I stated that my experiments had been conducted upon the London and South Western Railway, and were made, at the request of the directors, to ascertain the value of an invention which had been patented by their Locomotive Superintendent, Mr. Joseph Beattie. This contrivance will be readily understood by referring to the drawings on the walls, where the fire-box is shown in section, divided transversely into two compartments by an inclined water space mid-feather or diaphragm, and a dependent water space hanging from the roof. Both compartments are arched over with fire-tiles at narrow intervals apart. The boiler is constructed with a combustion-chamber, extending to about one-half its length, and it has a vertical mid-feather or diaphragm in the centre running parallel with its sides. The other half is supplied with tubes in the ordinary manner. The object of this contrivance is to increase the amount of direct heating surface, and to diminish the indirect, or tube surface; whilst the combustion-chamber affords sufficient space for the introduction of a series of fire-tiles, for the purpose of retaining a portion of the heat given off from the combustion of the gases in the fire-box, and for diffusing the unconsumed carbon, as well as effecting a complete mixture of the air with the gases, and thereby producing a mass of flame which is brought in contact with the direct heating surface of the combustion-chamber before it enters the tubes, at the same time preventing, practically, such an escape of smoke from the chimney as could be deemed a nuisance.

The back or first furnace is the most actively worked, the second being intended to carry incandescent fuel. The ash-pans are furnished with dampers for the admission of air when necessary; and this is also admitted through the small apertures in the fire-doors and through hollow stays in the fire-box.

In addition to the mechanical contrivances referred to, Mr. Beattie has another of considerable importance for using a portion of the exhaust steam for heating the feed water before it enters the boiler; and, as I have tried both his contrivances for this desirable object, I need only refer to the one represented on the drawing, which shows the pipes for conveying the water and steam to the tank under the foot-plate of the engine, from which the feed-pumps receive their supply. The water is received on to a perforated plate in this tank, and in its descent comes in contact with and condenses the steam, and thereby becomes heated; the supply of water is regulated by the ball-tap or valve, and the steam is admitted or shut off whenever the engine-driver has occasion to supply or shut off the feed-water to the boiler.

In the course of my first series of experiments, I have used the feed-water supplied by Mr. Beattie's apparatus, at a temperature of 196°.

I may here observe that I was anxious to obtain an analysis of the fuel used by the London and South Western Railway Company, and the more so as I found that they manufactured their own coke from "Ramsay's Coking Coal" (Newcastle), which is of a superior quality; and as it was desirable to ascertain, as far as possible, whether the coke or the coals which were supplied to me contained the greatest amount of sulphur, I sent samples of each to Mr. Dugald Campbell, Analytical Chemist to the Brompton Hospital; and he, after a careful examination, furnished me with the following statement, viz.:—

"The samples I received were four in number, and marked as follows:—

"No. 1.—Ramsay's coking coal.

"No. 2.—Coke.

"No. 3.—Llanguathog Merthyr, shipped Swansea, Neath, and Cardiff.

"No. 4.—Griff coal.

"No. 1.—RAMSAY'S COKING COAL

is of a jet sparkling appearance, and is broken up without much difficulty by the fingers into rather thick layers, between most of which are thin plates of iron pyrites, which, I may state, is a compound of iron and sulphur, in the proportion of one of the former to two of the latter. When the coal is reduced to a very fine powder—in which state it is required for analysis—its jet black appearance gives place to a considerable brown tint, which indicates it to be of a bituminous character.

"This coal is rather above the usual density of Newcastle coal, being 1,279, water taken as 1,000.

"The analysis in 100 parts is as follows:—

Carbon	85·57
Hydrogen	5·68
Oxygen	3·07
Nitrogen	1·48
Sulphur	1·46
Moisture	0·74
Ash	2·00
	100·00

* Paper read before the Society of Arts, Wednesday, 18th May.

"The calorific value of a substance is generally estimated in two ways: firstly by calculating from its ultimate analysis what quantity of water a known weight of the fuel would evaporate from 212° Fah.; and, secondly, by ascertaining how much oxide of lead is capable of being reduced to the metallic state by a known quantity of the fuel.

"These experiments when conducted upon the different specimens of fuel under precisely similar circumstances, which has been the case in this instance, give results extremely useful for comparing the economic value of the fuel. By such means, 1 lb. of No. 1 Ramsay's coking coal was found to be capable of evaporating 15·18 lb. of water from a temperature of 212° Fahr., and 1 lb. of reducing 34·99 lbs. of metallic lead from the oxide.

"No. 2.—COKE MADE FROM RAMSAY'S COKING COAL.

"The specimen I received of this substance was a thin column, which, from its appearance, must have occupied a space from the top to the bottom of the coke in the coking-furnace. An average sample was selected from this for examination, and the results obtained were as follows:—

"Density of coke, 1,055; water being 1,000.

"The analysis in 100 parts:—

Carbon	86·91
Hydrogen	1·32
Oxygen	0·10
Nitrogen	0·80
Sulphur	1·94
Moisture	1·28
Ash	7·65
	100·00

"One pound of this coke is capable of evaporating from 212° Fahr. 12·78 lbs. of water; and 1 lb., of reducing from the oxide of lead, 31·35 lbs. of metallic lead.

No. 3.—LLANGUATHOG MERTHYR.

"This coal has a bright sparkling appearance, resembling to some extent (No. 1) Ramsay's coal; but it is rather more dense, and not so easily broken; when broken, however, the layers are not so thick, and between them no iron pyrites are visible, but thin plates of silicate of lime are occasionally noticed.

"Density of coal, 1,333; water, 1,000.

"The analysis in 100 parts:—

Carbou	89·16
Hydrogen	4·06
Oxygen	1·65
Nitrogen	1·21
Sulphur	1·39
Moisture	0·67
Ash	1·86
	100·00

"One pound of this coal is capable of evaporating from 212° Fahr., 14·74 lbs. of water, and 1 lb. of reducing from the oxide of lead 34·74 lbs. of metallic lead.

"No. 4.—'GRIFF' COAL.

"This is a coal of a dull appearance, dense and hard, with a concoidal fracture, different from either of the other two coals.

"Density of coal, 1,341; water, 1,000.

"The analysis in 100 parts:—

Carbon	66·21
Hydrogen	4·09
Oxygen	11·07
Nitrogen	1·13
Sulphur	1·01
Moisture	9·23
Ash	7·26
	100·00

"One pound of this coal is capable of evaporating from 212° Fahr., 9·8 lbs. of water, and 1 lb. of reducing from the oxide 25·14 lbs. of metallic lead.

"In glancing at the above table, the first thing that arrests the attention is the proportion of sulphur being greater in the coke than in the coal from which it was made, and by nearly half a per cent.

"It appears from my analysis that, although in coking coal there may be a notable loss, in the per centage of carbon, hydrogen, oxygen, and nitrogen, in the coke, yet the sulphur has not only not decreased, but has actually increased in the per centage. I find in the coking oven that not more than one-twelfth of the sulphur goes off from the coal, whilst the loss of the other gases is upwards of one-third of the whole.

"But portions of the coke may be found to contain a very much larger quantity of sulphur than I found in the above specimen, and if I had selected a piece from near the top of the column, instead of taking an average of the whole, I should have found very much more than I did.

"The pieces of coke delivered to me by your assistant, which he told me he had taken from a quantity from the tender of an engine in going down to Southampton, on the 2nd ult., gave on an average 5·62 per cent. of sulphur, and some which I selected myself from the coke-heap at the Nine Elms station gave about 5 per cent.

"The next peculiarity to be noticed between the coke and the coal from which it is made is, in the amount of ash being very much higher in the former than in the latter. This is caused by an excess of iron and silica principally;

and were it not for the increase of ash there would not be so very much difference in their heating power, &c. I can only account for this increase in these two substances from their being volatilised in the coking ovens, and entering into the crevices of the fuel from which the gases escape.

"It is common to find large quantities of a hair-like substance adhering to the coke, varying in colour from a light grey to black. This is silica, with a trace of carbon and iron, and which has been in a state of volatilisation till arrested by coming to a cooler part of the coking oven, where it has condensed, and is found as I have described it.

"No. 3.—LLANGUATHOG MERTHYR COAL,

you will observe, is a coal of a very superior quality, and is nearly equal to Ramsay's coking coal in heating power, and has a very little less per centage of sulphur; but No. 4 'Griff' coal, though containing less sulphur than either, does not possess such heating power, which is partly owing to its containing a large per centage of water; this water is expelled when the coal is reduced to a fine powder, and submitted for some time to a temperature of 212° Fahr. The moisture in the other specimens was determined in a similar manner.

"I may state that my experiments were repeated, and great care was bestowed to verify any results which appeared contrary to what should have been expected, such as the larger amount of ash in coke, in comparison to the coal from which it was made, and the larger amount of sulphur in coke than in coal, the general belief being that in the coking of coal most of the sulphur is driven off."

TABLE OF FOREGOING RESULTS:—

	No. 1. Ramsay's Coking Coal.	No. 2. Coke from Ramsay's Coking Coal.	No. 3. Llanguathog Merthyr Coal.	No. 4. Griff Coal.
Density	1·279	1·055	1·333	1·341
Carbon	85·57	86·91	89·16	66·21
Hydrogen	5·68	1·32	4·06	4·09
Oxygen	3·07	0·10	1·65	11·07
Nitrogen	1·48	0·80	1·21	1·13
Sulphur	1·46	1·94	1·39	1·01
Moisture	0·74	1·28	0·67	9·23
Ash	2·00	7·65	1·86	7·26
	100·00	100·00	100·00	100·00
Pounds of Water which 1 lb. of Fuel would evaporate from 212° Fahr.	15·18	12·78	14·74	9·8
Pounds of Lead reduced by 1 lb. of Fuel	34·99	31·35	34·74	25·14

I will now proceed to give a detailed statement as to my mode of procedure to ascertain the quantity of fuel consumed per trip from the Waterloo Station, London, to Southampton and back again, inclusive of the quantity used in getting up steam in the morning, and whilst waiting at Southampton. I personally inspected the weighing of the fuel in the morning, and again at Southampton, and on the return of the engine to Nine Elms I took an account of the coal which remained on the tender, and I had the fire-box cleared out, the hot material cooled and riddled, and the worthless portion separated, and I allowed the value in good coal for the remainder.

I commenced my experimental trips with the coal engine *Ironsides*, which had been constructed on Mr. Beattie's patented plans, for burning coal only, and heating the feed-water, and took the 10·15 A.M. mail train from Waterloo to Southampton, and arrived there at 1·5 P.M. We commenced the return journey at 3·0 P.M., and arrived at the Waterloo Station at 5·58 P.M., the engine having performed the trip in a most satisfactory manner, and without any appearance of smoke, except when the steam had to be got up in the morning, or the fires prepared for the return journey.

The result of that day's trip will be seen by referring to the tabulated summary opposite November 15th, where the average consumption of fuel is shown as 16·71 lbs. of coal per mile, or when reduced to its coke value, equal to 11·14 lbs. per mile, with an average load of 12·2 carriages per mile, travelling at an average speed of 31·25 miles per hour.

I have said that the consumption of coal, when reduced to its coke value, was equal to 11·14 lbs. per mile; in explanation of my meaning, I beg to state experience has proved that, in order to make one ton of good coke suitable for locomotive engines, 1½ ton of the best coking coal is required, and with some kinds of coking coal, 1½ to 1¾ ton are necessary to produce 1 ton of coke. It will be evident then, that if the same load can be taken at the same velocity and under the same circumstances in respect to weather, with equal weights of fuel, say with coal in engines fitted up with Mr. Beattie's patented contrivance, and with coke in the ordinary class of engines, a net saving is effected of one-third, or 33 per cent. in fuel alone, without taking into consideration the incidental saving consequent on the construction of coke ovens, the interest on capital, the cost of their maintenance, and the wages of workmen employed in the manufacture of coke.

From the tabulated summary it will be seen that I worked the coal engine *Ironsides* for three days with little variation in respect to the quantity of fuel consumed, that little variation arising from the change in the weather. I then selected the coke-burning engine *Vesuvius*, one of the ordinary class, and being nearest in dimensions and weight to the *Ironsides*, and in good working order, and with it I took a similar train (10·15) to and from Southampton, burning coke only, and I adopted the same course of proceeding as on the former trips, but with a very different result as regards the consumption of fuel; for, on referring to the general summary, it will be seen that the average load was 12·1 carriages, the average speed 30·27 miles per hour, while the average consumption of fuel was 20·62 lbs. of coke per mile. On the following day I took the express train with the same engine, but the results were substantially the same as on the previous day with the mail train.

Having tried the *Vesuvius*, I decided upon taking another coke-burning engine (the *Frome*) which was a similar class engines to the *Vesuvius*, in order to ascertain if there was any difference in the results of their working. On referring to the summary of the trip opposite November 22nd, it will be seen that the consumption of fuel was remarkably near that of the *Vesuvius*.

I then determined to test the capabilities of another coal-burning engine, the *Canute*, and compare the results of its working the express train with that of the *Vesuvius*. The load was lighter, averaging 9·3 carriages, but the average speed attained was higher, being 36·76 miles per hour. The consumption of fuel was 16·71 lbs. of coal per mile, the coke value of which is 11·14 lbs. per mile against 20·62 lbs. per mile consumed by the *Vesuvius*.

The experiments up to this period showed a decided advantage in the coal-burning engines, so far as regarded economy of fuel, &c., but the results were not conclusive to my mind, inasmuch as the engines had not worked under precisely the same circumstances with respect to weather and uniformity of load and speed. I therefore obtained a sufficient number of carriages to form two trains of equal size and weight, and I had a quantity of materials weighed and placed in each of them equivalent to a load of passengers. The coal-burning engine *Canute* was attached to one of the trains, and the coke-burning engine *Vesuvius* to the other. The weight of the train, including engine and tender, drawn by *Canute*, was 170 tons 8 cwt., and that drawn by *Vesuvius* 167 tons 12 cwt.

The trains left London and Southampton within a few minutes of each other, so that there could be no difference between them in respect to weather, but lest either train should run heavier than the other from extra friction in the axle bearings, I took a second trip on the following day with the engines changed from one train to the other. I registered the particulars of each day's trip separately, but taking the average of the two days' working the difference in respect to consumption of fuel will be more readily seen.

	Average speed.	Average consumption of fuel in lbs. per mile.	Load.
Canute	28·40	Coal, 20·36	19 carriages.
Vesuvius	27·23	Coke, 24·37	19 carriages.

Coal reduced to its coke value, 13·57, which shows a clear saving of 10·80 lbs. per mile.

I subsequently tested the capabilities of the coal-burning engine *Canute*, for making sufficient steam when drawing heavy loads, and as this engine was rather heavier than the coke-burning engine *Vesuvius*, I obtained an additional number of carriages, and after they had been weighted I had twenty-eight of them attached to the *Canute*, and twenty-two to the *Vesuvius*, making the total weight of the *Canute* train 235 tons 13 cwt., and that of the *Vesuvius* train 189 tons 6 cwt. I was very desirous of testing the capabilities of the coal-engine *Canute*, for drawing a heavy load up the incline from Southampton to Andover (a distance of 22 miles) without the aid of a pilot engine, and for that purpose I added about 20 tons extra weight to its train beyond its proportionate load.

Early in the morning of December 19th, 1855, we proceeded to Southampton with the two trains, but unfortunately the water pipe attached to the lower part of the boiler in the *Canute* engine gave way, and the leakage therefrom became so great soon after we left Southampton, that we were obliged to pump into the boiler an extra supply of water to compensate for the loss sustained. A reference to the registered account of the trip on that day will show that while the *Vesuvius* (coke) engine evaporated 7·13 lbs. of water by 1 lb. of fuel, the *Canute* (coal) engine evaporated 9·05 lbs. of water by 1 lb. of fuel. The amount of water, therefore, which passed from the tender of the *Canute* engine was greater by 1·92, or nearly 2 lbs. of water per 1 lb. of fuel than that from the tender of the *Vesuvius*, but notwithstanding that mishap, the *Canute* generated sufficient steam to draw the twenty-eight loaded carriages up the incline without any aid whatever.

The firing from the same cause was increased, but the result on the day's work of the two engines was still in favour of the coal-burning engine, as will be seen from the summary, and it is worthy of remark that when the coal is reduced to its coke value, the result is 10·30 lbs. per mile in favour of the coal-burning engine *Canute*.

I have shown that the saving effected by the coal-burning engines with the ordinary trains was equal on the average to 8·56 lbs. of coke per mile, or 10·80 lbs. of coke per mile when each engine worked under the same circumstances as to weather, &c., with equal loads; now, if the former quantity, viz., 8·56 lbs. per mile be taken, the saving is equal to 1·348 lbs. on each trip, or at the rate of 187¾ tons per engine per annum, at six days' work in each week; but if the latter quantity, viz., 10·80 lbs. per mile be taken, the saving is equal to 1·721 lbs at each trip, or 239½ tons per engine per annum.

The consumption of coke by the coke-burning engine *Vesuvius* during one of the trips referred to was 29¼ cwt., which, at 31s. 6d. per ton, was equal to £2 6s. 6d., whereas the consumption of coal-burning engine *Ironsides* during another of the trips was 24¾ cwt., which, at 19s. per ton, was equal to £1 3s. 6d., giving a clear saving on the latter per trip of £1 3s. In my report to the Directors of the London and South Western Railway Company, I stated that if they had seventy engines in steam per day, and each of them was fitted up for burning coal, and all worked under similar circumstances to the *Ironsides*, there would be a daily saving to the Company of £80 10s., or £483 per week of six days, or £25,116 per annum.

SUMMARY OF EXPERIMENTAL TRIPS MADE ON THE LONDON AND SOUTH WESTERN RAILWAY.

DATE.	Name of Engine.	Description.	Average Time in Hours and Minutes.	Average Speed in Miles per Hour.	Average Feet Consumed in lbs. per Mile.	Coal Reduced to its Coke Value.	Quantity of Water evaporated per Mile in lbs. for 1 lb. of Fuel.	Highest Temperature of Water in Tender during each Trip.	Lead in Number of Carriages.	Weight of Train including Engine and Tender. Tons.	Cwts.	REMARKS.
1855. Nov. 15	Ironsides	Coal.	2·31	31·25	16·71	11·14	8·29	124°	12·2	....		Beautiful, clear, frosty day and calm.
„ 16	Ditto ..	Coal.	2·31	30·68	17·24	11·49	6·72	158°	10·6	....		Damp faggy day, rails greasy for 50 miles.
„ 17	Ditto ..	Coal.	2·39	29·71	19·02	12·68	7·07	164°	12·1	....		Clear day, with strong side wind, in favour of down and against up journey.
„ 19	Vesuvius	Coke.	2·36	30·27	20·62	..	7·15	76°	12·1	....		Wet drizzling rain, with light wind on our back.
„ 20	Ditto ..	Coke.	2·26	35·23	20·62	..	7·78	74°	12·2	....		Rails rather greasy; wind against down journey.
„ 22	Frome..	Coke.	2·27	32·14	20·97	..	7·62	94°	13·3	....		Ditto ditto ditto.
„ 23	Canute .	Coal.	2·11	36·76	16·71	11·14	7·35	168°	9·3	....		Fine clear day, with light wind in favour of down journey.
„ 30	Ditto ..	Coal.	2·49	27·65	20·51	13·67	8·26	142°	19·0	170	8	Fine frosty day; rails greasy for first 50 miles.
„ 30	Vesuvius	Coke.	2·56	26·54	23·82	..	8·21	54°	19·0	167	12	This was the first trip with equal loads.
Dec. 1	Canute..	Coal.	2·39	29·16	20·22	13·48	8·07	180°	19·0	170	8	Great difficulty in starting; rails slippery in consequence of frost and damp fog; wind rather stiff against us.
„ 1	Vesuvius	Coke.	2·47	27·92	24·92	..	7·78	54°	19·0	167	12	
„ 19	Canute..	Coal.	2·55	26·92	29·80	19·86	9·05	..	28·0	235	13	Frosty with strong head wind against us. Water-pipe in "Canute" gave way. Shut off heating apparatus.
„ 19	Vesuvius	Coke.	3·09	24·71	30·16	..	7·13	36°	22·0	189	6	

From the result of these interesting and important experiments I trust I have succeeded in demonstrating the truth of the assertions I made at tht meeting to which I have referred, namely, that coal can be used more economically in locomotive engines than coke; that by the use of coal sufficient steam can be generated to supply locomotive engines when working at high velocities and when drawing heavy loads; and, in support of my assertion relating to the capability of coal-burning-engines, built in accordance with Mr. Beattie's patent, consuming their own smoke, I have to observe that a goodly number of them are at work on different lines of railway, and testimonials of their efficiency have very frequently been given.

"There yet remains the question of the durability of the fire-boxes and tubes when coal is used instead of coke, and I do not think that I could offer a better proof of the superiority of coal over coke in this respect also, than by quoting a portion of a report which I made on this important subject on the 26th May, 1858, to the Locomotive Superintendent of the Manchester, Sheffield, and Lincolnshire Railway. The engines there referred to were built in accordance with Mr. Beattie's patent for burning coal and coke:—

"With respect to the durability of the tubes and fire-boxes, when coal is used instead of coke, I consider that question to be settled beyond dispute in favour of the former, inasmuch as it no longer remains a matter of opinion merely; but the result of contiuuous working with coal and coke demonstrates beyoud all doubt that not only is coal superior to coke in respect to heating power, and consequently decidedly more economical, but it is less injurious to both the tubes and fire-boxes of locomotive engines. As a proof of this I beg to append a copy of a tabular statement which I had the honour of laying before the directors of the London and South Western Railway, in the month of March, 1856, showing the average duration of a set of tubes in their locomotive engines when coke alone was used. At that time, as well as in the latter part of 1855, after I had made a series of experiments with coke and coal, I came to the conclusion that the tubes and fire-boxes would sustain less injury by the use of coal than coke; and although one of their coal engines had then run but 51,300 miles, aud no really appreciable depreciation had taken place in either fire-box or tubes, I saw sufficient to warrant me in concluding that the life of a set of tubes, as well as that of the fire-box, would be considerably prolouged by the use of coal instead of coke. Time has proved that the opinion I then formed was a correct one, inasmuch as I have, up to the present moment, carefully watched the effects produeed on the fire-boxes and tubes of the locomotive engines on the London and South Western Railway; and taking two of their engines which I have examined, where even part coke and part coal have been used up to the eommencement of the present month, you will perceive the amazing difference in favour of coal, when you compare the results with the tabulated statements copied from my printed Report, dated March 25th, 1856.

MILES RUN BY THE UNDERMENTIONED COKE ENGINES, WITH ONE SET OF TUBES, ON THE LONDON AND SOUTH-WESTERN RAILWAY:—

Working Pressure of Steam.	Name of Engine.	Miles run.
100 pounds	Volcano	118,978
100 „	Stromboli	127,855
100 „	Vulcan	128,947
100 „	Milo	104,627
100 „	Etna	105,985
90 „	Ruby	101,905
90 „	Serpent	92,048
80 „	Medusa	106,590
100 „	Windsor	99,907
100 „	Mercury	73,100
80 „	Fire King	102,258
80 „	Mazeppa	89,059
100 „	Sussex	99,624
100 „	Mars	103,257
100 „	Comet	97,201
80 „	Hawk	74,955
80 „	Acheron	87,759
100 „	Test	76,182
100 „	Stour	69,688
100 „	Rocklia	86,469
100 „	Avon	78,785
100 „	Trent	65,634
100 „	Frome	83,108

Average duration of tubes, 94,518 miles.

"From the above table you will perceive the average duration of a set of tubes was 94,518, whilst in the two engines I have referred to, where coal and coke have been used, one of them has run 154,955 miles, and is now carryiug 120 lbs. pressure of steam, none of the tubes having failed, and they are still in good working condition, and I am unable to say how much longer they will last. The other engine has run 137,676 miles, aud I have had two of her tubes sent to my office in Queen's Chambers, Manchester, which you can see at any time.

"I personally paid a visit to the works at Nine Elms and examined these engines; and, bear in mind, that although a portion of the fuel used in these engines is coke, yet the tubes I now refer to have only worn to the extent of three wire gauges in thickness; they were ordered and made to No. 13 wire gauge, and are now No. 16 wire gauge.

"No doubt exists in my mind that the principal portion of this amount of reduction in thickness is attributable to the cuttiug action of the coke, and not to the effect of any deterioration produced by the action of the coal. With regard to the effect on the fire-box of the latter engine, the back, sides, and crown, are $\frac{1}{32}$ of an inch less than their original thiekness, namely, $\frac{1}{2}$ an inch; the tube-plate has been reduced $\frac{1}{16}$ of an inch, the original thickness being $\frac{5}{8}$ of an inch. From these facts you will be able to draw your own conclusions—they speak for themselves—for in one case, where coke alone was used, you have an average (taken from the Company's books) of 94,518 miles as the life of a set of tubes, whilst in the other, where coke and coal are used on the same railway, and working similar trains, you have 154,955 miles run in the one case, and 137,676 miles in the other, and the tubes still in good working condition.

"I have given you these facts as a sample of the results when coke and coal are used, because the fuel you are using in your engines is of a similar character; but I am prepared to prove that were your engines constructed to burn coal alone, the fire-boxes and tubes would be protected from the cutting action of the coke, and greater durability, much beyond the mileage I have reported for coke and coal, would be the result. I am not ignorant respecting the argument that some persons have advanced as to coal containing a greater amount of sulphur than coke; this is a fallacy which I have had proved beyond doubt, and therefore I hesitate not to give you a strong opinion in favour of coal, for instead of its proving destructive to fire-boxes, tubes, or smoke-boxes, the result of my observations and experiments proves the contrary."

In further confirmation of the inereased durability of the tubes, I beg to state that the mileage of another engine of the same class as the two referred to, and burning a mixture of coke and coal amounts to 181,589 miles, and the tubes are still iu good condition, and working at a pressure 120 lbs. to the square inch.

In conclusion I beg to remark, that previously to the year 1853, several attempts had been made by different individuals to introduce coal as a substitute for coke in locomotive engines, but from various causes they did not persevere in developing its true commercial value, and I would take this opportunity of stating that the credit of this important saving in railway expenditure is due to the skill and persevering industry of Mr. Joseph Beattie.

DISCUSSION.

The Secretary read the following communication, received from Mr. D. K. Clarke, who says:—I perfectly agree with Mr. Fothergill in assigning to Mr. Beattie the honourable position of pioneer in the successful practical introduction of coal as a substitute for coke in locomotive engines, as there can be no question that, by his persevering efforts, he first succeeded in fairly arousing public attention to the real magnitude and importance of the economy in working expenses in railways that might be effected by the general use of coal as fuel. I believe that from this source of economy alone an addition of nearly 1 per cent. may be made to the dividends on the original share capital of railways, taking one with the other, with the reduced tear and wear of locomotives so ably pointed out by Mr. Fothergill. I think, however, that the mode adopted in the paper, of illustrating the saving in cost effected by the substitution of coal for coke, is open to criticism, and does not place the question on its proper basis. It is true that the quantity of coke manufactured from a given weight of coal weighs only two-thirds of the original coal so consumed, and that 1½ ton of coking coal make only 1 ton of coke. But in seeking to establish this ratio of three to two as the measure of saving, that is, that the cost of fuel is reduced one-third in dispensing with the coking process, it is overlooked that coking coal, as coal, is not the proper fuel for locomotives, and that therefore the calculation of saving should be based, not upon the relative quantities of coking coal and of coke made from it, but upon the relative prices and efficiency of proper locomotive coal and coke. This ratio is necessarily very variable, as it is affected by cost of transport and other elements. For instance, on one metropolitan line, whilst coking coal costs 12s. 6d. per ton, and the coke made from it costs 18s. 6d., other coal, suitable for locomotive uses, costs as much as 15s. per ton. On another line, whilst the cost of coke is 23s. per ton, the coal suited for locomotives costs 20s. per ton, or only 13 per cent less. Again, take the North Eastern Railway, at Newcastle, the difference of the cost of coke at from 8s. to 11s., and locomotive coal, at 7s. per ton, is so inconsiderable as to scarcely make it worth while to use coal on that line. Notwithstanding such local approximations in cost, there can be no doubt of the economical importance of the question before the meeting. Again, in the comparison of the coal-burning engines with the coke-burning engines of the South-Western Railway, no allowance has been made for the benefit of heating the feed-water in the former, as against the use of cold water in the latter; whereas my own experience with Mr. Beattie's engine, the *Canute*, showed a most material increase in the consumption of coal when the feed-water was not heated. The following were the results I obtained from the engine with hot and cold water respectively:—

	Average train.	Coal consumed per mile.	Temperature of feed-water.
With heated water	11 carriages......	17·4 lbs.......	191 deg.
With cold water	11 ditto........	24·0 lbs.......	56 deg.

Showing an increase of 6·6 lbs. of coal per mile, by using the feed-water cold, as was done in the coke-burning trials recorded by Mr. Fothergill. The coke value would therfore be 16 lbs. per mile and not 11 or 12 lbs., as assumed in the Paper, for comparison with the coke-burning engines. The large extra consumption of coal, by shutting off the heating apparatus, is, no doubt, greater in proportion than would be deducible from the known constituent heat of steam and water; but it is caused also by the less favourable working conditions of the engine involved in the use of cold water. I hope, on another occasion, to bring the results of my own practice in coal-burning without smoke before the Society.

ON THE BURNING OF WELSH STEAM COAL IN LOCOMOTIVE ENGINES.*

By Joseph Tomlinson, Jun., Esq.

(Continued from page 120, May Number.)

Mr. Tomlinson showed specimens of the various descriptions of coal, and of the firebrick before and after using it in the engine fire; and explained that the firebrick was merely broken up into small pieces of about 3 in. cube, and thrown in rougbly with a shovel in a single layer over the grate, so as to cover the firebars; it was found to last a long time, and in one special trial that he had made to ascertain its durability the fire was not dropped for six days, the engine running continuously 100 miles per day, and at the end of that time the firebrick still remained as an efficient protection for the grate bars.

The Chairman inquired what clay was used for the firebrick.

Mr. Tomlinson replied that it was the local fireclay from the Rhondda Valley, which answered well. The thickness of the fire was an important point: it might be 9 or 10 in. thick at the sides, where the absorbing surfaces of the firebox kept down the temperature; but should be as thin as possible in the centre, so that the bars could just be seen through it, for the bars would go down in the centre in spite of all precautions unless the fire was kept very thin, on account of the intense heat.

* This Paper was read at the meeting of the Institution of Mechanical Engineers at Birmingham. This acknowledgment was accidentally omitted in the previous notice of this Paper.

In the table of experiments the injurious effect of increased speed was remarkably shown, not only in increased consumption of fuel, but also in diminished evaporative duty of the fuel, which was reduced about 10 per cent. by an increase of speed of 5½ miles per hour or about 50 per cent.

In the trial that he had made of Newcastle coal, the coal used was some that had been tried in steamboats in comparison with Welsh coal, and he had made a trial of a small quantity in a locomotive; it was half small coal, and therefore would not serve for comparison with the large Welsh coal used in the experiments: but the trial showed that the bituminous Newcastle coal demanded very different circumstances for its economical consumption, requiring a much greater supply of air; it consequently received imperfect treatment in ordinary locomotive fireboxes, where no provision was made for an extra supply of air beyond that admitted through the grate; so that the evaporative duty obtained in the trial was only 5¼ lbs. of water per lb. of fuel.

The results of the trials in consumption per ton per mile were not always thoroughly reliable as a means of comparison, on account of the great fluctuation in the weight of trains down, some being as much as 700 or 800 tons down hill, which would materially affect the result; the fall was nearly uniform from one end of the line to the other, amounting to 409 ft. in 24 miles, or an average gradient of 1 in 309. The trains wanted scarcely any power down hill, and required the break to regulate the speed, which was not allowed to exceed 12 miles per hour on account of the number of heavy trains upon the line.

Mr. J. E. Clift asked what was the comparative cost of the different kinds of fuel used in the experiments, as that was an important point in the question of the use of coal in place of coke.

Mr. Tomlinson replied that the coke cost 12s. 6d. per ton, and the coal 6s. 8d. per ton, in the waggons upon the railway; so that the cost of fuel when coal was little more than half of that with coke, as the consumption was about the same in quantity to do the same work.

Mr. R. Laybourn said he had made some trials of burning Welsh coal in locomotives on the Monmouthshire Railway about 18 months ago, with coal from Nixon's Deep Duffryn seam, the same seam of coal as the Aberdare Four Feet Vein, but found the bars came down in the same way as had been described. This was, however, obviated by using inferior coke for lighting the fire, which formed a portion of clinker over the bars that served to protect them; by this means he succeeded in using the coal. The difference in price between coal and coke was considerably less in that instance, the Nixon's Deep Duffryn coal costing 11s. 6d. per ton on account of having to be conveyed over two or three different railways; while the best coke cost 15s. per ton, and inferior coke 12s. to 13s. per ton.

He had been driven to investigate the subject of coal-burning in locomotives about two years ago by the difficulty experienced in the supply of coke, and made a series of experiments, which led him to the adoption of a considerable proportion of coal mixed with the coke for the locomotives on the Monmouthshire Railways. In the half-year ending December, 1855, and previously, coke alone had been used, at an average rate in that half-year, of 40 lbs. per mile for all the trains, passenger and goods, costing 3·12d. per mile of the trains for fuel. In the following half-year to June, 1856, a quantity of coal was mixed with the coke; and in the next half-year to December, 1856, this was increased to an average of 22·73 lbs. of coal per mile and 17·85 lbs. of coke, making a total consumption of 40·58 lbs. per mile, at a cost of 2·56d. per mile of the trains for fuel. The proportion of coal was then further increased, and the results were—

In the half-year ending	Coal.	Coke.	Total Consumption.	Cost of Fuel.
June 1857	39·25 lbs.	5·60 lbs.	44·85 lbs. per mile.	2·09d. per mile.
Dec. 1857	39·71	5·20	44·91 ,,	2·13d. ,,
June 1858	34·15	7·21	41·36 ,,	2·10d. ,,

The coal used was steam coal of a semi-anthracite and semi-bituminous quality, obtained from the Monmouthshire valleys, on the eastern side of the Welsh coal district; it was not so anthracite as the Welsh steam coal which was found at some distance westward from the district of the Monmouthshire Railways, in the Aberdare and Swansea valleys.

The Chairman asked whether he had tried covering the grate with firebrick.

Mr. R. Laybourn said he had not tried firebrick, but by getting up the fires with inferior coke a clinker was formed over the grate, which was found to answer the purpose of protecting the bars; the Monmouthshire coal was not so liable to burn the bars as the Welsh coal, but it was still requisite to use it with a thin fire.

Mr. J. Fenton inquired whether the weight of the trains given in the particulars of the experiments included the engine and tender, as that was important for any comparison with the results obtained on other railways.

Mr. Tomlinson replied that the weights given were those of the trains alone, independent of the engine and tender, which would add about 45 tons—the engine being about 29 tons weight and the tender 16 tons.

Mr. B. Fothergill had been engaged recently in an extensive series of experiments on the comparative value of coal and coke as fuel for locomotive engines; and the results of his observations led him to agree entirely with the statements in the paper, as to the efficiency of coal for locomotives in place of coke; and that the quantity of coal required was not greater to do the same work, if suitable provision was made for its proper combustion. His experiments had been made with the partially bituminous coal of Lancashire and Yorkshire; and he had also made one trial with the Welsh smokeless coal in a locomotive engine, but it was impracticable to complete that trial in consequence of the fire-bars melting down upon the trip so as to stop the engine after having run only a short distance. It was not from defect of the coal that this stoppage of the trial took place, but entirely from the melting of the fire-bars; and it was evident that without some provision for protecting the bars from melting, the Welsh smokeless coal could not be employed in locomotives.

The question of coal-burning in locomotive engines was a highly important one, and called for the careful attention of railway companies, as to the saving to be effected in their working expenses by the substitution of coal for coke. In two trials he had made, the cost of fuel for taking the same train over the same distance of 96 miles was found to be—

With coke at 11s. 6d. per ton............. 22s. 3d.
With coal at 5s. 3d. per ton............. 9s. 5d.

Showing a saving of 57 per cent. in the cost of fuel consumed when coal was used. He should be happy on a future occasion to bring before the Institution the particulars and results of the trials; and was glad to say he had come unreservedly to the conclusion that there was no necessity for noxious volumes of smoke being discharged from locomotive engines with the use of coal, but they might always be made to burn their smoke satisfactorily. There was not only a great saving in cost of fuel attending the use of coal, but a great convenience to the drivers in keeping up the steam better than with coke; and those accustomed to it would rather run a coal-burning engine, if the smoke were consumed, than a coke engine.

There was another point of great importance to be noticed in reference to the subject,—the relative durability of the boiler tubes and fire-box with coal and with coke; and after the practicability of using coal with great economy in cost of fuel had been established, this became a serious question in deciding whether to go on making coal-burning engines instead of coke engines. It had been feared at first that there would be a loss from more rapid destruction of the brass tubes and copper fire-box with coal than with coke; and he had been recently engaged in an investigation of the subject on the Loudon and South-Western Railway where coal-burning engines had been worked for a long time, for the purpose of ascertaining the real lifetime of the tubes under the two circumstances. The result was found to be that in twenty-six coke-burning engines the average duration of a set of brass tubes was 94,518 miles, varying from 65,000 to 127,000 miles, according to their quality and the description of coke used. But in several engines running with half coal and half coke the tubes had run 154,955 miles, and were still in good working condition; and in one of these engines the tubes after 137,676 miles' work were not half worn out, and were reduced in thickness only from No. 13 to No. 16 wire gauge, or from ·095 in. to ·065 in. From the results of this investigation he was satisfied that the ordinary wear of the tubes was caused mainly by the cutting and abrading action of the hard particles of coke drawn rapidly through the tubes, and was not entirely a chemical action as had been at first supposed; and consequently the comparative softness of the particles of coal greatly reduced this cause of wear. This was illustrated by the wear that ordinarily took place in the fire-boxes of coke engines, in which the roof and upper portion were reduced only $\frac{1}{32}$-in. in thickness, whilst under the fire-door and at the lower part of the sides were exposed to the continued wear of the hard pieces of coke the thickness became reduced $\frac{1}{8}$-in. in the same time. He was satisfied that the durability both of tubes and fire-boxes would prove much greater with coal alone; and that there was no ground to fear more chemical action from sulphur with coal than with coke.

Mr. J. E. Clift inquired what proportion of sulphur there was in the Welsh steam coal, as it was not stated in the analysis given in the Paper.

Mr. Tomlinson replied, that the quantity of sulphur was very small, and was included in the 2·13 per cent. of nitrogen, &c.; in the Four Feet Vein the proportion of sulphur seldom exceeded from 1 to $1\frac{1}{2}$ per cent., and was never more than 2 per cent.

Mr. W. G. Craig said he was completely satisfied, from the results of working of the engines, that the tubes had a much greater durability with coal than with coke; and the same result had been obtained on several other railways where the trial had been made: when using two-thirds coal and one-third coke the tubes were found to be still in good working order after running 150,000 miles, but with coke they were worn out in about 100,000 miles. For the purpose of burning coal he had used a firegrate constructed with each alternate bar raised 1 in. above the others, making a kind of hollow fire, leaving spaces for air to enter under the fuel; the bars were not found so liable to burn in that arrangement as with a level grate, being protected by a greater supply of air on their top surface; a set of bars now lasted several weeks with coal, instead of only one week as before when they were all level. The saving in cost of fuel would vary on different railways according to the relative price of coal and coke, and a saving of 30 per cent. in total cost of fuel had been effected by the use of coal upon the Manchester, Sheffield and Lincolnshire Railway. The quantity of fuel consumed per mile was less with coal than coke with good drivers, but it required the men to be accustomed to the working of the fuel in order to obtain the full results from coal: the fire had to be kept very thin, and in passenger engines the bars could frequently be just seen in the centre of the fire; there was then always a bright flame from such a fire, effecting the combustion of the smoke, and keeping up the steam better than with the lower temperature of a coke fire; while with coke the fire had to be heaped up almost to the door, and much of the fuel was lost by being carried away unconsumed through the tubes.

Mr. J. Fenton observed that the low evaporative duty obtained from the Newcastle coal, when burnt without consuming the smoke, showed the great importance of insuring a sufficient supply of air for bituminous coal, and a considerable larger quantity than was required for a coke fire.

Mr. W. Smith remarked that he had used a construction of cast-iron channelled fire-bars by Mr. Gray, in which every alternate bar was raised about $1\frac{1}{2}$ in. above the rest; sloping notches or channels were made across the top edges of the bars, to afford an increased area for supply of air. Several sets of these bars were at work in London, burning coal, and they appeared to answer satisfactorily, giving an increased supply of air for the perfect combustion of the fuel, and lasting longer than the ordinary bars, from the greater cooling effect of the air.

Mr. Tomlinson said he had tried a set of Mr. Gray's fire-bars for a stationary-engine grate under a large Cornish boiler, but had not found there was much advantage over a set of thin cast-iron bars which he had tried in a companion boiler of the same description; the latter bars were $3\frac{1}{2}$ in. deep by $\frac{5}{8}$ in. thick at top, and $\frac{1}{2}$ in. at bottom, with $\frac{3}{8}$ in. spaces. In both boilers the fire-doors were perforated in the same manner as the locomotive fire-door, and provided with sliding shutters to close the air holes; there was also a damper below the fire to shut up all close when the incline was not being worked. He thought that in practice the channels across the bars were more frequently filled with dust than clear, and hence the absence of any good effect resulting from them. The bars that he used for locomotives were of wrought iron, $4\frac{1}{2}$ in. deep by $\frac{5}{8}$ in. thick at top, and $\frac{5}{16}$ in. at bottom, with $\frac{3}{8}$ in. spaces when new. In some engines the same set had lasted five months when burning about 45 lbs. of coal per mile, and running about 500 miles per week: their average duration was about three months, which was gradually increasing.

Mr. R. Laybourn observed that an important consideration in the matter was the great variation in the quality of coal obtained in different districts, so that a special plan had to be arranged on each different railway to suit the coal to be used there. The Monmouthshire railways afforded a remarkable illustration of this, as they comprised five different lines diverging from one locality, and running up five separate valleys which had each a different quality of coal, the quality changing successively from the most eastern valley where it was highly bituminous, to the most western where it was semi-anthracite. The Aberdare and Swansea coals were still more anthracite, and were situated further westward. He had made trial of a plan of firegrate by Mr. Jeffreys, of the Shrewsbury and Hereford Railway, in which the bars were laid flatways, on the side instead of the edge, with air spaces between and partly overlapping one another, forming a gradually sloping surface from each side of the fire-box down towards the centre; this arrangement proved successful in admitting a larger supply of air, and he found it effective in burning the bituminous coal.

The Chairman observed that this was similar to Mr. Crampton's firegrate that was used on the French railways, except that in the latter the bars were laid transversely instead of longitudinally in the fire-box, forming a surface sloping down from the fire-door towards the tube plate.

Mr. E. A. Cowper observed that in Mr. Gray's plan of fire-bars that had been referred to, the general arrangement, he believed, was to have $\frac{1}{2}$ in. bars and $\frac{1}{2}$ in. air spaces, giving 50 per cent. area of opening in plan for the admission of air; but the effective area was increased to 60 or 70 per cent. by cutting sloping notches in the top edges of the bars, so that portions of the top surface of the bars were cut away. He did not know what were the results of their working, but thought the use of very thin bars fully answered the purpose required. He usually employed bars only $\frac{1}{2}$ in. thick at top and $\frac{1}{4}$ in. at bottom, with $\frac{3}{8}$ in. spaces.

Mr. Tomlinson said that a set of Mr. Gray's fire-bars had been tried for some time in the *Iron Duke* locomotive engine on the Great Western Railway; but he did not think any plan of stepped grate would be suitable for burning the Welsh coal, for he found that if any one of the ordinary bars was accidently left standing up above the others, from the notch in the fire-bar frame not being cleaned out, it was sure to get burnt more than the rest.

M. E. A. Cowper had heard that a plan had recently been tried in some locomotives on the Great Western Railway, for tipping up the entire firegrate upon a centre bearing, so as to allow of laying the fresh fuel on the bars, and then covering it over with the red fire when the grate was tipped back again sharply.

Mr. R. Laybourn believed that was Mr. Jeffreys' plan, and was intended as a mode of making cast-iron bars suitable for locomotive firegrates. This was effected by never disturbing the cast-iron bars on their bed, and they were never removed until worn out; but when the fire had to be dropped the whole frame was tipped over on a centre bearing, allowing the fuel to drop out. This plan gave great economy in the cost of maintenance of fire-bars, as cast iron was used instead of wrought iron bars; and the bars were preserved from injury by avoiding the handling of them whilst hot, which was liable to bend or break them.

Mr. J. Fernie said an arrangement of ridged fire-bars had been tried for a stationary engine boiler at Derby, on Mr. Chanter's plan, in which the top of the bars was ridged or serrated, and every alternate bar moved longitudinally about 1 or $1\frac{1}{2}$ in. backwards and forwards—the intermediate bars remaining stationary; the alternate bars were moved by a transverse shaft provided with a lever, which was moved occasionally by the stoker. These had been in use about two years, and were found to answer the purpose satisfactorily; the ridges on the bars served to keep the fire gently stirred, preventing clinkers from adhering to the bars.

Mr. W. G. Craig observed that for burning coal it was requisite to have the bars rather close together and very thin, considerably more so than with coke; and the object he had had in view in using a grate with the alternate bars raised above the others was to admit more air under the fuel, making a kind of hollow fire, to prevent the bars from burning. The fire-bars he used were $\frac{5}{8}$ in. thick at top, and $\frac{1}{2}$ in. at bottom, with $\frac{3}{8}$ to $\frac{5}{8}$ in. air spaces; and when placed alternately raised they could be brought still closer.

Mr. J. E. Clift inquired whether a pan of water had been tried under the fire-grate, to prevent the bars being burnt; that plan was frequently used in stationary engines with good results, and by this means he had had fire-bars in constant use for two years with intense coal fires under gas retorts, without the bars burning away. There was constantly a supply of water under the firegrate, and the steam rising from it served to keep the bars continually protected and cool.

Mr. Tomlinson said he had tried a jet of water from the boiler kept continually running under the firegrate of a locomotive during the whole trip, but it did not serve to protect the bars from burning. He had not tried a pan of water, but with the jet there was so much water constantly supplied as to keep the ashpan full of steam; and he thought the effect would be the same as in the use of a pan of water.

Mr. T. T. Chellingworth remarked that a water pan was generally used under the firegrate in agricultural engines, with good results in preserving the bars.

Mr. C. W. Siemens observed that the efficiency of the water below the firegrate would depend a good deal upon the quantity of ashes falling from the fire; if the ashes fell easily they would keep up a supply of steam from the ashpan, and preserve the bars from injury; but if much clinker were formed on the firegrate, the water pan would not answer, as there would not be steam enough to keep the bars cool.

Mr. J. Fernie thought the Paper that had been read was very serviceable, as the introduction of a particularly important subject, and he hoped it would lead to a series of papers on coal-burning; for it was most essential to the railway companies to be able to use coal, and nearly all of them were now entering into the matter as to the saving both in cost of fuel and in expense of renewal of tubes and fire-boxes. On most railways experiments were now being made on the subject, and many different contrivances with firebrick and other plans were being tried; on the Midland Railway they were now engaged in experiments for the purpose, and he would be happy to give the results at a future time. He thought that something very simple was wanted, and did not see why the object should not be satisfactorily accomplished in time. The object of burning coal without smoke in locomotive engines had been well effected by means of complicated apparatus; but they were obliged to consider the large stock of coke-burning engines at present on the railways, and the consequent impracticability of changing them for coal-burning, unless this could be done at a moderate cost and slight trouble of alteration.

As to the effect of sulphur in coal upon locomotive tubes, it might be noticed that in the early engines of the Liverpool and Manchester Railway, the tubes were of copper, brazed with brass, and a chemical action was found to take place upon the copper from the sulphur in the fuel; but with the present brass tubes the case was quite different, and there could be no doubt that the wear was entirely due to the mechanical action of the hard particles of coke cutting away the metal.

The Chairman observed, that the discussion had proved highly interesting and valuable, and he hoped it would be continued by another Paper on the subject at a future meeting.

He moved a vote of thanks to Mr. Tomlinson for his Paper, which was passed.

INSTITUTION OF CIVIL ENGINEERS.

ON THE PERMANENT WAY OF THE MADRAS RAILWAY.

By Mr. McMasters.

(Continued from page 125, May Number.)

Allusion was made to a system of enabling the double-headed rail to be used without chairs. This was by suspending the rails between a pair of longitudinal balks, contoured to the rail channels. The rail and timbers were bolted together by flat bolts, 3 ft. apart. The joints of the rails were connected by brackets of angle iron, to a cross tie of timber. By this plan a thinner web could be used, and therefore a deeper rail for a given weight. When it was wished to reverse the rail, it was not necessary to disconnect the rails and the timbers, but merely to take out the joint bolts. It was believed that this system would induce economy, as no chairs were used, and less timber and ballast would be required than on an ordinary cross-sleeper road. A length of 150 yards of this way had been laid for six months on the main Cambridge line, at Stratford, where the ballast was bad and the traffic great. The timber used was only cross-sleepers cut down the middle. It made a good road, and there was a perceptible difference in passing on to it, from the other portions of the line.

It had been stated, that the compressed keys were liable to shrink in hot climates, and that some, which had been allowed to remain on the sea coast, in India, had swollen so much as to be unfit for use. On the Lisbon and Santarem railway, an oaken key, 10 in. in length, and slightly tapered, had been substituted; and this plan was about to be tried on the Madras railway. The employment of an iron key, with a thin cushion of wood between it and the chair, the timber being cut across the grain, was suggested as an alternative. In defence of compressed keys, it was remarked, that what had been stated was scarcely so much the necessary cause of the defect of the key, as the way in which the keys were used. Twenty millions of these fastenings had been supplied for the railways in India, or sufficient to lay 2,200 miles of road, and no complaint had ever been made, until quite recently. The author of the Paper had said, that the compressed keys lasted better than those which were unprepared; and it was also believed, that the loss from premature expansion had been inappreciable during the period of three or four years during which they had been used on the Madras railway. But being aware that the amount of dry heat to which they would be subjected, with iron on both sides of them, might have a tendency to cause even compressed keys to shrink, until they were thoroughly saturated with moisture, they had lately been made larger than usual, so as to receive a greater degree of compression. It was understood that hundreds of casks of keys had been lying exposed to the heat of the sun, for months after their delivery in India, and until the staves of the casks opened. If there had been any expansion of the tightly packed keys, the casks would have been burst open. With proper care, however, it was maintained that they would have remained without fault.

It was thought that one of the main points arising out of the Paper was, whether it was desirable to construct permanent-way in India with timber, or with iron-sleepers. As the cost of renewal, irrespective of ordinary maintenance, amounted, on lines in this country, to £100 per mile per annum, of which sum about 37 per cent. was for the renewal of the rails, and 63 per cent. for the substructure, attention had been directed to the use of cast-iron for sleepers, which had been proposed and tried in many different forms. In Egypt, Greaves's spheroidal cast-iron sleeper, with the chair cast upon it, had been found best suited to the soil and climate. There was little or no ballast on the course of the line, so that it would have been difficult to have found a foundation for the ordinary sleeper. Trough sleepers of cast-iron, in which the rail was suspended between linings or cushions of timber, so that in the case of the double-headed rail, the lower table was not injured, and the rail could therefore be reversed, had been in use for nine years on the Eastern Counties, and for two years on the South-Eastern and the Midland Railways. In the latter case, they were laid near to the Derby station, where they were subject to a traffic of 550 engines, 2,400 waggons, and 120 carriages, every twenty-four hours. A modification of these two forms, which might be denominated the "cup-trough," had recently been proposed, in which the chair was entirely dispensed with, so that there were no projecting parts liable to fracture. Tie-rods passed through the neutral axis of the rail, with square washers of unequal thickness placed in the side channels, secured both the angle and the gauge. This form of sleeper was stated to be applicable to any ordinary section of rail, without alteration of pattern, was said to be inexpensive in manufacture, and to be easily maintained, as it was packed through dormer holes at the sides, which were believed to afford greater facility than holes at, or near the top. For shipment, they could be stowed into one another and save space. It was assumed, that the first cost of a substructure on this system would amount to £910 per mile of single way, and on the ordinary system to £551 per mile, taking the cross-sleepers at 4s. each, and the chairs at £4 10s. per ton. But it was contended, that the timber sleepers would require to be renewed twice in twenty-one years; for although the timber might be rendered chemically durable, the destruction would go on nevertheless, and when the time arrived for the renewal, the timber would be valueless, whilst the cast iron would be worth two thirds of its original value. It had been estimated that the saving, by the use of iron, would amount to £1,058 per mile, of single line, in a period of twenty-one years, after allowing interest for the original outlay in both cases.

In regard to the durability of timber sleepers, it was asserted, that when properly creosoted, they lasted much longer than would be inferred from the comparison just made. Scotch fir sleepers, laid on the Eastern Counties, in 1841, had remained perfect to the present time, not one having been removed on account of decay. Between the years 1840 and 1842, creosoted sleepers had been laid on the Manchester and Crewe, which were still sound; and indeed, in re-laying the line with heavier rails two years back, some sleepers that had been in wear sixteen years were employed. The sleepers for the East Indian railway were weighed previously to being placed in, and when taken out of, the cylinder, in which they remained twenty-four hours, under a pressure of 124 lbs. to the inch, in order that 10 lbs. of creosote per cubic foot might be forced into them. Some triangular creosoted timbers, which had been sent to India, had shown symptoms of decay, due, it was believed, to their being of hard wood, and to the form not being the best for the purpose, as the angles were liable to be damaged, and thus expose the uncreosoted portion of the wood. Timber should be stacked and properly seasoned before being creosoted, and it had been found that heart-wood was not so easily creosoted as young sappy wood, as it was impossible to make it absorb the necessary quantity to preserve it thoroughly. In the latter case, after a few years, the creosote set into a solid bituminous mass; but only the thin and volatile portions entered heart-wood, and these were liable to evaporate quickly when the sleepers were used in a hot climate. Specimens of sleepers which had been "Burnettized" in 1841, and laid at that time on the Eastern Counties Railway, were shown to be quite sound at the present time. With respect to unprepared wood, instances were given of the sleepers having been said to have lasted many years, but the evidence was not conclusive. It was stated that good sound larch sleepers were in some cases preferable to Scotch fir that had been creosoted, and that it would last equally long. It was observed, that it was impossible to subscribe to the principle which had been advocated, that wood of the lowest quality, or young timber, full of sap, and which sucked up a large quantity of creosote oil, should be selected for use, because it was favourable for creosoting. It was believed that the best results would be obtained, when the utmost care was taken in selecting the woods. A good result was tolerably certain under these circumstances, and in corroboration it was mentioned, that timber laid in 1835, some of which was Kyanized, although the preparation merely entered to the depth of 1-10th in., and some of which was unprepared, had lasted till the present time. St. John's yellow pine had been proved to be one of the most durable woods, both for railway sleepers and marine works. At the Liverpool and the Sunderland Docks, there were instances of its being quite fresh after being in use twenty years.

With regard to marine works, it was said that the worm would not touch timber which was creosoted to the depth of 2 in. or 3 in. around the pile. When, however, this coat was cut through, the worm would penetrate into the heart-wood, but when it reached the creosoted portion, it was stopped by the objectionable nature of that material. This had been proved to be the case at Lowestoft, where the creosote was found to be generally a preservative against the ravages of the worm. In all cases the timber should be cut for framing before being creosoted. It was remarked that, although in general creosoting doubled the duration of timber, yet the creosoted piles of the pier at Leith showed symptoms of being attacked by the worm. An instance was also mentioned of the worm penetrating a balk of creosoted Memel at Scrabster, Caithness, and having eaten through the blackened portion, although the pile had been in the sea for less than six months. To this it was replied that the discolouration of the wood afforded no correct test of the timber having been properly creosoted; and it was suggested whether the work of destruction might not have commenced before the balk was creosoted, as there was hardly a log from Memel which was not more or less penetrated by some kind of worm. Kyanizing was asserted to have no effect, as the corrosive sublimate combined with the sap of the wood, and formed a substance which was not poisonous, and could be eaten by the worms with impunity.

It was thought that sufficient stress had not been laid on the importance of utilizing, as far as possible, the resources of the country in which the works were being carried out. In Ceylon, for instance, there were forests of almost interminable extent which might be made available. Eighteen different samples of timber had been examined, at least nine of which were applicable for railway sleepers, in situations where they would be exposed to extreme variations of atmosphere and weather. The drainage of railways in tropical climates was a matter of the utmost importance, as the ballast was liable to be carried away by the heavy periodical rains. In reply, it was intimated that the necessity for sending out timber sleepers to India arose from the circumstance that the supply there could not be relied on. There was great difficulty in determining the precise value and quality of woods in foreign countries, especially when such practices were carried on as steeping the wood in order to deceive, as had been the case in Madras.

In closing the discussion, the great diversify of opinion that still prevailed on this subject was commented upon. Every one appeared to think his own plan the best, and naturally preferred to be guided by his own experience, rather than by that of others. As to the question of the durability of timber, whether prepared or not, and, if prepared, then by what process, few persons were able to obtain reliable data as far back as twenty or thirty years. The Minutes of the Institution would contain a variety of opinions on this subject, but it was doubted whether the question could be solved, or whether there could ever be universal agreement as to what was the best system of permanent way to be used under all conditions.

After the meeting, Mr. Curtis explained a system of axle boxes, in which, by centrifugal action, the oil was constantly thrown over the upper side of the axle, and descending slowly upon the axle was returned again to the oil chamber. As soon as it had passed the axle, a piece of thin porous flannel, placed at the bottom of the oil chamber, was found in practice to answer as a filter to receive the parts of the metal, or other residuum, resulting from the working of the boxes. These boxes were now at work on eight railways in England and on one in France. They had been in use for upwards of eighteen months; in some cases they had run for two months without any oil being applied; but the ordinary practice was to introduce about a wine-glass full of oil to each box once a week.

April 19, 1859.

Joseph Locke, Esq., M.P., President, in the Chair.

The Paper read was "Description of the Entrance, Entrance Lock, and Jetty Walls, with the Wrought-iron Gates and Caisson, &c., of the Victoria (London) Docks," by Mr. W. J. Kingsbury, Assoc. Inst. C.E.

This Paper had chiefly for its object to bring forward an account of some special works, which from their magnitude and peculiarity presented novelty and interest; it was, therefore, rather a contribution to the history of the Victoria Docks, than an attempt to convey a complete idea of that undertaking.

The Victoria (London) Docks were briefly described as being situated in that part of the Plaistow marshes, Essex, which, projecting forward towards the south-east, was bounded on three sides by the River Thames, which there formed a loop, or bend, extending from Bugsby's Reach, just below Blackwall, to Galleon's Reach, below Woolwich.

The entire area, comprised within the dock, was shown to be about 200 acres, of which one half, or 100 acres, was water space. This consisted of the entrance, with its lock—the tidal chamber of 16 acres, and the main dock of 74 acres. In general terms, the basin and dock together, were 4,050 ft. in length, and 1,050 ft. in width, at the level of high-water mark.

In addition to the quay room afforded by the sides of the basin and dock, four jetties, each 581 ft. long, and 140 ft. wide, were projected from the north side, into the dock; these jetties, with the sides of the dock and of the basin, provided a length of three miles of quay space.

The general surface of the original marsh land was about 8 ft. 6 in. below Trinity high-water mark; and the tidal water of the Thames was always excluded by an embankment, which was maintained at a height of 5 ft. above T. H. W. M.; that level was, therefore, adopted for the top of the copings of the entrance and of the lock walls. Taking T. H. W. M. as the datum, the bottom of the docks was stated to be 24 ft. below datum,—the depth on the upper gate cill 25 ft. 6 in., and on the lower gate cill 28 ft., which latter depth was maintained throughout the entrance from the river; and as the mean fall of tide was 18 ft., there was a depth on the lower gate cill of 10 ft., and on the upper gate cill of 7 ft. 6 in., at Trinity low water mark.

The subsoil was described as consisting of beds of yellow and blue clays, of varying thickness, and of a total depth of 5 or 6 ft.; then a depth of from 5 to 12 ft. of peat, and then a good bed of gravel overlying the London clay, which was found throughout the length of the lock at a nearly uniform depth of 37 ft. below T. H. W. M., and on this foundation, at a depth of 37 ft. 6 in., both the upper and the lower gate platforms were laid.

The sides of the entrance, of the channel leading to the tidal basin, and of the lock, were composed of concrete walls, faced with cast-iron piles and plates. The main piles were driven at intervals of 7 ft. 1 in. from centre to centre, the intervening space being filled by cast-iron plates, whose lower edge rested on the upper end of four cast-iron sheeting piles, which with them occupied the entire space between each pair of the main piles. These latter were each in two lengths: the lower 25 ft., and the upper 12 ft. 8 in., and the metal was about 2 in. thick, cast in a trough form, 18 in. in width. The sheeting piles were each 20 ft. long, of similar form: the three interspacing iron plates for every bay were each 5 ft. 11 in. wide and 5 ft. deep, cast with back feathers to give the necessary strength, and provided with a top flange to carry the stone coping of the wharf. In the rear of each main pile, and at a distance of 18 ft. from it, a timber land tie, 20 ft. long, was driven to a proper depth, and secured to the iron piles by two eye-bolts and nuts, and behind them a wall of concrete was filled in, varying in thickness from 12 ft. to 6 ft. at the top, where the stone coping of the wharf was laid. The main piles were driven 5 ft. into the ground, and the sheeting piles about 2 ft. 6 in. into the same stratum. Clay puddle and concrete were also used to render the lock chambers perfectly sound.

As the London clay was met with at a depth of 37 ft. below T. H. W. M., advantage was taken of the circumstance to dispense with an invert, at the gate platforms, by substituting ordinary brickwork. This was accomplished by laying open, down to the clay, the necessary areas for the upper and lower platforms—surrounding them by single rows of elm sheet piling 16 ft. long and 9 in. thick, driven close, to a depth of about 7 ft. into the solid clay; these were secured by wailings, and within the spaces so secured the brickwork of the platform was laid. In this mode of construction it was essential to take out all the gravel; to lay the bricks directly upon the clay, and to use close piling, in order to prevent the possibility of any water getting beneath, and blowing up the brickwork. Upon these platforms the side walls, which were 20 ft. in thickness where they joined the concrete walls, were carried up in brickwork.

The hollow quoins for the gates, the external arris of the gate recess, the caisson quoins and cill, and the copings and bedstones for the anchors, which constituted the bulk of the stone work employed, were of a compact sandstone, called Duke's quarry stone. The bricks used were almost all made from clay excavated from the site of the docks, laid in mortar composed of Halling lime and clean sharp sand; the latter also from the excavation, whence the gravel and sand used in the concrete also proceeded; so that these essential ingredients for the structure were found on the spot.

The Paper then described the sluices and the pipes for filling and emptying the lock, with the precautions for examination and repair, and in general it appeared, that every facility was provided for access to every part liable to wear and tear, or injury, and for remedying all defects.

The cost of the piled and concrete wall of the lock chamber was stated to be £17 0s. 7d. per foot run, and that of the entrance to be £19 5s. 10d. per foot run, or £51 and £58 per yard run respectively. The price of the cast iron at the time of the construction of the docks was £6 per ton; and the weight of iron averaged about 1¼ ton per foot lineal of the wall.

A description was then given of the three pair of lock gates—viz.: the lower and upper gates of the entrance lock, and the inner gates separating the tidal basin from the main dock. All these were constructed of wrought iron, nearly alike in dimensions and general arrangements. The objections to the use of timber were enumerated—the introduction of cast-iron ribs, with timber planking, was noticed, and the gradual employment of wrought iron for the frame, the plating, the diaphragms, and all the parts, except the heel and mitre posts, was described. It was shown, that on account of the large dimensions of these gates, and more particularly their amount of curvature, timber would have been inapplicable; the lower gates being 80 ft. in the span, by 31 ft. in height, with a versed sine of 20 ft., or one-fourth of the span. The form of the outer curve of the gates was an arc of a circle, having a radius of 50 ft.; the distance between the skins, at the heel and mitre posts, was 2 ft., and at a point midway between them 3 ft., the inner boundary being two arcs of circles struck from centres 9 ft. 5½ in. apart, with a radius of 59 ft. 9½ in. There were fourteen horizontal diaphragms in each lower gate, the distances between them varying from 1 ft. 11 in. at the bottom, to 3 ft. at the top. Beneath the bottom plate, which was ⅝ in. thick, a piece of timber to meet the shutting cill was fixed by bracket pieces. The horizontal diaphragms generally were ½ in. thick, and were attached to the skins by T and angle irons. There were also two vertical diaphragms passing continuously from top to bottom, and dividing each gate into three equal parts. These tended to prevent twisting, and added strength to the structure. The outside plating varied in thickness, according to the strain to which it was subjected, from ⅞ in. at the bottom to ⅜ in. at the top. The plates were disposed with their lengths vertically, and all the joints were provided with strips on the outside and on the inside, to render the structure watertight.

The heel and mitre posts were of green-heart timber, and were firmly attached by angle irons and bolts to the gates. The chain attachments were made to draw upon both skins and upon the entire frame of each gate, and to be accessible at low water; the gates were opened and closed by Armstrong's hydraulic machinery.

The peculiar arrangements for the moveable hand-rails of such curved gates were then described; and it was shown that by the use of swivel sockets, the curved rail could be made to shut down quite close to permit the passage of the towing ropes.

The pivots and foundations were then described, as were the shutting cills, with the means of securing them, the roller paths, and the rollers, the latter demanding peculiar arrangements on account of the curved form of the gates and their great weight. They were so arranged as to be easily accessible outside the gate, and by releasing a nut, the column which fitted into a recess in the upper part of the roller-frame could be removed, and the roller could be drawn up by chains in the guides, be examined, and repaired if necessary, and be restored to its place without disturbing the gates.

The large anchors were also fully described, as were the modes of securing them.

The upper and inner gates were stated to be somewhat lighter than the lower and outer gates, the material was thinner, and there were fewer horizontal diaphragms; in other respects all the gates were nearly identical. The inner gates were not worked by hydraulic power, and the sluicing was done directly through four apertures in each of the gates themselves, instead of through the side walls.

The weight of metal in the gates was:—

WROUGHT IRON.

In the inner gates, including the cast-iron pivot stop piece	198 tons.
Ditto, in upper gates	128 „
Ditto, in inner gates, including sluices.	138 „

CAST IRON.

In the shutting cills, pivot crosses, anchors, rollers, roller paths, foundation plates, &c., with the bolts for each pair of gates	59 tons.

The ancient river bank, which was about 5 ft. above T.H.W.M., and protected the marsh from the overflowing of the river into the low district, formed a natural dam, behind which the inner works of the lock chamber, the brickwork of the gate openings, and the other operations were carried on, and outside of which a considerable portion of the piling and the concrete walling was executed. But in order to effect the junction of the two portions, and to complete the entrance works, it was necessary to remove a large quantity of material by barrow, and then to resort to dredging below low-water mark. To admit of this being done simultaneously with the other works of the dock, it was essential to provide the means of keeping the water out of the dock, whilst the river bank was broken through and carried away. A coffer dam would have been expensive and tedious; recourse was therefore had to a caisson, which was constructed of wrought-iron plates, and from its great size, and the peculiar mode of using it, the description became very interesting. The ordinary form of a caisson was well-known to be something like that of a ship, with a raking stem and stern, and fitting into grooves in the side-walls, whilst the keel applied itself close down against a shutting cill.

The new caisson was built of a rectangular form in its side elevation, the heel-posts being vertical and shaped like those of the gates, so as to fit into a hollow quoin, as into a kind of rebate. In plan it was similar to one leaf of the gates, being 3 ft. wide in the middle and 2 ft. at each end, and it was large enough to extend across the span of 80 ft. between the lock walls; its curvature was not great, the rise, or versed line, being 8 ft., the outer and inner curves being struck with radii of 94 ft. 8 in. and 104 ft. respectively. The height of the caisson was 31 ft., and there were five horizontal close diaphragms in that height, including the bottom and top plates. It was thus divided into four spaces, the lowest of which was 4 ft. 1 in. high, the second was 9 ft. 2 in., the third 10 ft., and the fourth, or upper space, 7 ft. 9 in. There were also two vertical diaphragms, from the bottom to the top. The position of the lower horizontal diaphragm was designedly fixed, so that the internal capacity of the bottom space should be equal to 25 tons of water. There was a bottom lining piece of Memel timber to meet the shutting cill. There were also two rectangular sluices, one opening through the bottom lower compartment, by which the water could be admitted to fill the dock; and another, of small area, on the concave side, opening into the lower compartment, by which it could be filled, when required. A three-throw pump, with gearing for emptying the caisson, was fixed on the top.

The hollow quoins for the caisson were built of Duke's quarry stone, and were placed in the walls, where they began to rake back from the perpendicular to meet the batter of the piling.

In using the caisson, its total weight being about 90 tons, if the water-space was pumped out, it would float with the convex side downwards, nearly in a horizontal position. On the small sluice being opened, the water entered the bottom compartment, and caused the caisson to tilt gradually into a vertical position, during which time it was drawn towards its position, between the quoins and the heel-posts fitted into them. Thus, with a caisson of this form and construction, no greater depth of water than just enough to float it was required to get it out of its place, and as soon as it was free from the quoins, it could be turned on its back, so as to present very little surface to the wind, and in that position it was perfectly manageable.

The construction of the jetties, which had been already incidentally noticed, with regard to their position and general dimensions, was then described. The general form was that of a parallelogram, 497 ft. long and 140 ft. wide, terminated by a pointed end, the sides of which were 109 ft. 6 in. long, and met at an angle of 80°, making the extreme length 581 ft. The height of the quay was 6 ft. to 9 ft. above T. H. W. M., according to the situation of the jetty in the dock.

On the jetty a warehouse was built, 500 ft. long and 80 ft. wide, consisting of vaults and two floors of nearly an acre in extent each. The outside space of 30 ft., on each side, to the edge of the quay, was appropriated to railways, and the temporary storeage of goods. Facilities for discharging and arranging goods were provided by hydraulic cranes; one capable of lifting 5 tons with a range of 31 ft. being placed at the pointed end, and eight others, arranged in pairs, sweeping outwards from 21 ft. to 23 ft., and capable of lifting two tons each, were placed at intervals on the sides of the warehouse. There were also turntables and sidings, for the purpose of collecting and distributing the waggons on the main line of railway leading from the docks.

The side walls were described as a combination of cast-iron piles, vertical brick inverts and concrete, with a backing of clay.

The piles which were ┳ shaped in section, and 35 ft. long, weighed about 1¾ ton each. They were driven to a depth of 28 ft. below T. H. W. M., at intervals of 7 ft. Between them, the brick inverts, which were 14 in. thick, were filled in; and behind this the concrete was carried for an average thickness of 3 ft. 6 in. The piles were connected to each other across the jetty by two tiers of tie bars, 2 in. in diameter, and 12 ft. apart; the upper one being placed 5 ft. below the heads of the piles, and by means of them the piles were secured from being forced outwards, and could be adjusted in line. The bottom of the walls was commenced one foot below the bottom of the dock, and the wall itself was considerably strengthened at the pointed end, to enable it to bear the blows to which it was exposed, and as a foundation for the 5-ton crane. The top was finished off with a cast-iron capping and wood cill, secured to the heads of the piles; and the upper surface of the jetty was ballasted, and some portions planked. As a precaution, the angle formed by the upright face with the floor of the dock was filled, to some height, with clay puddle, to prevent the passage of water under the wall.

The total cost of each jetty, exclusive of the warehouse and cranes, was £12,000, or £10 per foot run of the quay.

It was noticed that an incident which at first threw some doubt on the capability of the walls to resist the passage of water, was afterwards satisfactorily accounted for. It was explained that the floor of the vaults under the warehouses was about 2 ft. 6 in. above the marsh level, and 6 ft. below that of the water in the dock at T. H. W. M. When the water was first admitted, it appeared in the vaults, and it was found necessary to remove it by means of drains. This, which was supposed at first to result from leakage, either through, or under the walls, was soon found, from its containing iron, to be water from the gravel, which in this district rose to within a short distance of the surface, and in this case gained access to the vaults by means of the concrete walls of the warehouse. The discharge from the drains was now very slight; the diminution being attributed to the consolidation of the ground against the walls, and to the silting up of the porous materials by the rusty deposit found in the water. It was remarked, in corroboration of this explanation, that quite recently the discharge from one jetty entirely ceased during the time that the level of the water in the gravel was kept down by pumping to get in the foundations of a new warehouse in the immediate vicinity, but was re-established shortly after the pumping was discontinued.

The casualties which occurred during the construction of the dock were fully described; these were comparatively few for a work of such importance.

The first, which was the fracture of the cast-iron shutting cill, arose from the subsidence of the ground under the heavy side walls being greater than that of the brick platform, to which the shutting cill was bolted down. The side walls subsided about 1½ in., and in consequence the cill was cracked near the centre. The defect was soon discovered and as speedily remedied, by bolting a plate of wrought iron on the back of the cill. This accident pointed out the importance of allowing the side walls to settle before the holding-down bolts of the cill were finally tightened.

The next casualty occurred in the lock chamber, where, without any premonitory symptoms of weakness, and almost simultaneously, both sides of the chamber, between the upper and lower gates, moved bodily forward, pushing up the thick puddle towards the centre, bending and breaking the tie-bars behind, and dragging the tie-piles forward, fracturing several of them, whilst, however, the brick side walls of the gate platforms remained entirely uninjured. Very energetic measures were adopted for reinstating the walls. The old concrete was cleared away, the iron piling was driven 10 ft. lower than previously, the sheet piles entering 5 ft. into the clay, in which a solid concrete wall was commenced at a depth of about 5 ft., and was carried up for a height of 18 ft., with a thickness also of 18 ft., above which it was reduced to 10 ft. in thickness, with counterforts projecting 6 ft., with a breadth of 6 ft., and at intervals of 10 ft., nearly up to the top of the piles. On this mass of concrete a brick wall was built, 10 ft. high, averaging 4 ft. 6 in. in thickness with counterforts 3 ft. square, and at intervals corresponding with those below. The piles were secured to the concrete walls by means of iron rods passing through them to cast-iron plates, to which they were screwed up tight at the back. The clay puddle was removed from the bottom, and was replaced by a mass of concrete, with a top layer of Portland cement concrete 6 in. in thickness. The damage was completely repaired in three months, and no signs of weakness were subsequently perceived. This casualty was accounted for by the previous draining of the ground all around, due to the constant pumping during the progress of the works; and on the cessation of this process the water rising behind the walls occasioned additional pressure, which forced the sides inwards. That the failure resulted from this cause was demonstrated by the fact of the movement of the two sides being nearly simultaneous.

The next casualty which occurred, was the fracture of two of the pivot castings of the lock gates. This was shown to have arisen from the binding of the brass socket upon the iron pivot, so that the pressure, instead of being distributed over the whole area of the step, was restricted to a comparatively small annular portion; thus the brass "seized," or adhered to the pivot to such an extent, that the gate, instead of working upon the pivot, turned upon the brass and burst the sides of the box in the effort to free itself. At this period, also, the gates were leaky, in consequence of some of the joints not being tight, and the weight upon the pivot being much increased. The mischief was aggravated by hydraulic power being employed to open and shut the gates, and thus the undue resistance was not so soon perceived as if capstans, worked by manual labour, had been employed for a short time after the completion of the gates. This course was recommended as a prudent precaution in similar cases. The cause of the casualty being ascertained, the remedy was easy, and was speedily applied.

The last casualty was the splitting of the roller path, which was a direct and intelligible result of the previously mentioned leakage, having rendered the gates so much heavier than the casting had been intended to bear. This was remedied by rendering the gates watertight, and in putting down a new path, the surface for the roller was made 7 in. wide, instead of 4 in., and no difficulty had since been experienced. These casualties were very fully detailed, as being, perhaps, more useful than any other part of the Paper.

The latter portion of the Paper was on some advantages of the form adopted for the Victoria (London) Dock gates, with respect to economy of material and general arrangement.

The term "cylindrical," or gates of continuous curvature, was adopted to distinguish them from those formed like a Gothic arch, and was employed to denote that the outer or convex curves, constituting both leaves, were struck from one centre, or formed portions of one and the same circle. The inner boundary was formed in the same way, or not differing materially from it.

Before proceeding to compare this form of gate with that of straight gates meeting at an angle, it was stated that no advantage was claimed for the former in respect to the amount, or direction of the strain brought on the lock walls, but in regard to the section of the gate itself, even in ordinary cases, there was believed to be considerable superiority.

A few preliminary remarks were then made on the strains to which these structures were exposed; that in the cylindrical gate a compressive strain was induced by the pressure of the water, which was uniform on every radial section in the same horizontal plane (though, of course, varying with the depth); while in the straight gates meeting at an angle, there were two strains, first, a transverse strain caused by the pressure of the water, and similar to that on a girder uniformly loaded; and, secondly, a compressive strain, arising from the pressure of the other leaf on its extremity. The compressive strain on any horizontal section of the cylindrical gate was stated to be equal to the pressure on the unit of surface, multiplied by the radius of curvature, as shown by Professor Barlow (*vide* Trans. Inst. C.E., vol. i., p. 133). The important distinction between the two kinds of strain to which straight gates were exposed, was pointed out by Mr. P. W. Barlow, M. Inst. C.E., in his Paper on Lock Gates, at page 67, in the volume already cited.

Some examples were then given, showing that this compressive strain in the straight gate varied very considerably, according to the ratio of the height or versed sine, to the span; and consequently the importance of providing sectional area to meet this, as well as the strain, induced by the direct action of the water on the leaf itself. With regard to the distribution of this strain in the two skins, the problem was not capable of accurate solution, in consequence of several practical modifying circumstances, but it was thought sufficient for the purpose of comparison, to assume the equal distribution, especially as that view was in favour of the straight gate.

Some examples were then given in detail, for the purpose of instituting a comparison between the weights of gates required for spanning the same opening with the same rise or versed sine, when made in the cylindrical form, and also with straight leaves meeting at an angle. The results were shown in the following Table:—

Ratio Rise to Span.	Vertical Angle.	Transverse Strain in Centre.	Compres. Strain due to Op. Leaf.	Straight Gate.		Cylindrical Gate.	
				Mean Section.	Quantity of Material.	Mean Section.	Quantity of Material.
1 to 10	157° 22′	69·32	102·0	29·6	1207	26·0	1066
9	154° 58′	69·94	92·3	28·4	1164	23·6	975
8	151° 26′	70·82	82·5	27·25	1123	21·25	885
7	148° 10′	72·08	72·9	26·25	1092	19·0	801
6	143° 8′	74·06	63·3	25·3	1069	16·66	715
5	136° 24′	77·32	53·8	24·8	1011	14·5	640
4	126° 52′	83·33	44·7	24·9	1117	12·5	580
3	112° 38′	96·27	36·0	26·0	1250	10·8	552
2·66	106° 16′	104·15	33·3	28·0	1400	10·4	558

Some remarks were then made on several other practical advantages arising from the cylindrical form, in utilising sectional area, avoiding to a great extent unequal thicknesses of plates, and rendering the operation of caulking more easy and efficient. At the same time, certain objections were mentioned, and it was stated that additional cost would be incurred in the manufacture of the cylindrical gates; but it was thought, notwithstanding, that the following propositions were fairly established:—

1. That a lock gate of the cylindrical form could be made with about half the quantity of material required for a straight gate.
2. That with the same ratio of rise to span a saving of from $11\frac{1}{2}$ to 55 per cent. might be effected in the skins alone, and that a further saving might be made in the horizontal diaphragm.
3. That by this mode of construction great facilities were afforded for rendering the gates watertight, and greater certainty be attained in accomplishing this very desirable object.

LITERARY AND PHILOSOPHICAL SOCIETY, MANCHESTER.

Adjourned Annual Meeting, May 3rd, 1859.

W. Fairbairn, F.R.S., &c., President, in the Chair.

Mr. H. M. Ormerod produced two specimens of iron used in building, which had both become oxydized so as to injure the buildings which they had been used to strengthen. One, an iron cramp, taken from the north-west buttress of Manchester Parish Church, about 1 ft. long and $\frac{3}{8}$ in. thick. This had become treble the thickness by rust, and had split the buttress, in the centre of which it was inserted, lifting about 12 ft. of wall. It had been inserted about ninety years since. The other, a small wedge, from the steeple St. Mary's Church, in Manchester, about $\frac{3}{8}$ in. thick at the broad end originally, but now $\frac{7}{8}$. These wedges had lifted all the stones which they were meant to keep in their places, splitting some, and allowing all the rain to penetrate. The steeple was erected about 1756, and the upper part has now become so ruinous and dangerous from the original faulty construction, and the expansion of the iron cramps and wedges, that it is being taken down, pursuant to notice from the city surveyor.*

Dr. Joule having taken the Chair, a Paper was read by the President, W. Fairbairn, F.R.S., entitled Experiments to Determine the Effects of Different Modes of Treatment on Cast Iron for the Manufacture of Cannon.

After commenting upon the importance of the treatment of iron in the manufacture of cannon, and on the want of knowledge upon this subject, exhibited in the failure of many of the guns employed in the Russian War, the Author proceeds to describe the processes usually adopted in the foundry for the improvement of iron, under the heads mixing, remelting, and prolonged fusion. The value of remelting and mixing iron has long been recognised, and their effect in increasing the tenacity of the metal has been fully demonstrated by experiments. Lately the influence of prolonged fusion had also been the subject of inquiry, and the conclusion had been arrived at that a continued exposure of liquid iron, to an intense heat, augments the cohesive powers of the iron in proportion to the duration of the exposure, up to some not well ascertained limit where the oposite effect begins to be produced, and the iron deteriorates.

The Author then proceeds to narrate the results of some experiments in which he was engaged in 1855, on the improvement of cast iron ordnance. Five twenty-four pounder guns were cast of a carefully-selected mixture of the following qualities of iron:

Blaenavon, No. 1	2.2	per cent.
Blaenavon, No. 2	16.7	"
Blaenavon, No. 3	28.9	"
Lilleshall, No. 2	35.5	"
Pontypool, No. 3	16.7	"

In casting these guns it was sought to determine the effect of various modes of treatment in the foundry: hence,

Gun A was cast in the usual way, with 3 ft. 6 in. head.

Gun B was cast from the air furnace, of iron remelted once before casting into the mould.

Gun C was cast from the cupola, with desulphurized coke.

Gun D was cast from the air furnace in the usual way, under a pressure of 17 ft. 6 in. of head.

Gun E was cast from iron remelted once, and then run into mould, under 17 ft. 6 in. head of metal.

These guns having been bored and turned, were conveyed to Woolwich Marshes, and subjected to proof by firing, beginning with the usual proof charges, with a gradually increasing quantity of powder and weight of shot, until the gun burst. The result of these proofs is exhibited in the following table:—

Gun.	Number of Rounds Fired.	Total Quantity of Powder used, in lbs.	Total Weight of Shot Fired, in lbs.	Total Number of Wads used.
A	33	364	3120	91
B	32	350	2952	90
C	17	150	1152	43
D	31	336	2784	89
E	33	364	3120	91

From this table it will be seen that, whilst the gun cast with desulphurized coke from the cupola, exhibited comparatively a great inferiority,† the guns E and A, one of which had been cast in the ordinary way, and the other with remelted iron, under pressure, exhibited very high powers of resistance. The results thus obtained were further confirmed by experiments upon the tenacity and density which gave the following mean results:—

Gun.	Density.	Tenacity in lbs. per sq. in.
A	7.2105	28,516
B	7.2325	27,219
C	7.0863	18,101
D	7.2032	25,954
E	7.2441	28,516

After discussing the results of these experiments, in some respects anomalous, gun A being a peculiarly fortunate cast, it appeared that the other guns were improved by the remelting and pressure of head, so as to give the best result with E, which had been subjected to both these processes. In conclusion the author alludes to experiments on guns cast with a core, and expresses his belief that the great practical difficulties which beset that process must prevent its application, although theoretically calculated to produce guns of greatly increased strength.

* After grinding and polishing the iron rust, it presented a black iridescent surface of almost metallic brilliancy, and similar, in appearance, to Elba ore. It was capable of being made into a magnet of considerable power and retentiveness.—J. P. J.

† Considerable want of uniformity is observable in iron melted in the cupola, unless retained for some time in a state of ebullition at a high temperature. This will account for the comparative weakness of the gun C, which, under different treatment, would have been greatly improved by the use of desulphurized coke, as was found to be the case in former experiments.

REVIEWS AND NOTICES OF NEW BOOKS.

Engineering Precedents. By B. F. Isherwood, Engineer in Chief of the United States Navy. London and New York: Balliere.

Last month the distinctive feature of the above work—the distribution of power in marine engines, treated analytically and synthetically—was alluded to; and, in referring to any or all of the experiments detailed, it will be necessary to take for granted the truthfulness of such distribution of power, if we are to realise and apply the information given by the Author.

Although, as we before stated, Mr. Isherwood has not placed his readers in a position to decide upon the correctness of the data for determining some of his calculations, we are inclined to give the credit due to an *approximation* towards a right estimate of the elements composiug the force propelling a steam-ship.

Putting aside for a moment the details of analysis, we have given us, in each case, the power assumed to be utilised in the actual propulsion of the ship.

For instance, in the despatch steam-ship *Lynx*, as a smooth-water trial result, there is a net power of 253·34 horses applied to the screw-shaft, and only 175·55 H.P. realised in actual propulsion; thus, 30·7 per cent. of the net power is required to overcome friction of the load, friction of screw, and slip of screw; and if we take the *gross indicated*, instead of the *net* power, or 281·49 horses, then 37·7 per cent of such gross power is required to overcome the friction of the engine's load, screw, and slip.

In the screw steam-ships *Sydney*, *Ireland*, and *Scotland*, the horses power required to overcome friction of engine, load, and screw, and slip of screw, are given respectively as 31, 37, and 31·7 per cent. of the gross indicated power developed.

Now, these results of calculations and experiments are so far in accordance with others realised by dynanometrical experiments on board Her Majesty's steam-ship *Rattler*, that we are disposed to look favourably on the analysis giving such results. With the *Rattler*, the dynanometer, in one instance, indicated a thrust on the propeller-shaft equivalent—when taken in conjunction with the speed of the ship—to 72 per cent. of the gross indicated power, thus leaving 28 per cent. to overcome friction of engine, load and screw, and slip.

Comparing this result with that given of the *Sydney* (both ships having geared engines), there is a difference of 3 per cent. in favour of the *Rattler*. The question is—where such a difference exists, to what extent is it dependent upon the friction of engine, load, or screw? In comparing the *Sydney* with the *Rattler*, we do not mean to imply that the two cases are strictly comparable, but only to direct attention to the importance of having all data for calculation founded on truthful experiments.

Mr. Isherwood gives no information on the comparative efficiencies of marine engines, but takes it for granted that the only difference in their friction is fully accounted for by allowing $2\frac{1}{2}$ lbs. per square inch on the piston for the high-pressure engine, $1\frac{3}{4}$ lbs. for the geared, and $1\frac{1}{2}$ lbs. for the direct-acting condensing engines.

In estimating the friction of the load, all engines—geared and direct-acting, condensing, or high pressure—are treated alike, it is only when we come to the propelling instruments that calculations become precise; and here the Author appears quite at home, and gives his readers some very practical observations on one of the most difficult subjects connected with Steam Navigation. In our first notice we referred to the want of information to explain the data, &c., on which the Author has founded his rule for ascertaining the "cohesive resistance of the water to the surface of the screw," and until that information is supplied, the remarks and calculations on the experiments of the *Lynx*, *Conflict*, *Sydney*, *Ireland*, *Scotland*, *Spencer*, and *Mac Lane* cannot be fully appreciated.

Among the screws tried on the *Conflict*, one of the common kind was fitted with a central boss, on Griffith's plan, but inasmuch as the blades were not tapered, the experiment could not be considered in any way conclusive, as the central boss and taper blades form one system. The Author states his belief that no particular form of boss or blade will exceed, in efficiency, a well-proportioned common screw, with expanding pitch; as the opinion of a practical and scientific engineer, holding an influential position, we quote the Author's own words in concluding the *Conflict's* experiments.

"From the experiments, c and e, and the boomerang, it appears how useless are any attempts to increase the efficiency of screws by modifying the outline of the blades; no tapering of the latter out or in, or inclinations of them from a perpendicular to the axis, either in a longitudinal or lateral direction, and no removals radially of the surface, by substitution of globes around the hub, or by other means, can add anything to the propulsive efficiency of the helicoidal surface, and they generally entail serious practical inconveniences. The only improvement possible on the true screw of uniform length from hub to periphery, is that due to the use of an expanding pitch or curved directrix."

This is laying down the law rather strongly on a subject that is yet in its infancy.

For several reasons the experiments made with the paddle steamship, *Mac Lane* and the screw steamship, *Spencer*, are of small value to the marine engineer of the present day, except for special service, the paddle has been quite superseded by the screw, not on account of the actual efficiency of one or the other, but for reasons too well known to be repeated here.

Then the experiments made by the Admiralty are more practical and decisive than those given in the work before us. As *precedents*, the trials of the *Mac Lane* and *Spencer* do not deserve the space and attention given to them—without indicator or dynanometer diagrams to give the actual power,—with paddle-wheels having a dip equal to nearly half the radius; and, consequently, smothered in a sea-way,—propelling a hull that "would neither 'lay to' nor could be kept by the wind,—" would not 'stay'" and was difficult to "wear" —destitute of stability, such a paddle-steamship is compared in efficiency, during certain trials in fine and foul weather, to a screw-steamship, having precisely the same form and size of hull, but fitted with two screws, one under each counter, known in this country as Carpenter's arrangement.

We are inclined to the opinion that comparative trials between *such* a paddle-steamship as the above, and a description of screw-steamship not adopted in the steam marine of any country, are valueless to the practical engineer.

We must not forget to notice the author's explanation of the differences existing in the efficiency of steam-ship propulsion, when spoken of as to the fuel consumed in a given time, or as to the gross indicated power developed. We refer the reader to the discussion on the results of the several experiments for full information on this point; also to the table at page 30, in which the distinction between fuel and power is clearly shown.

No attempt is made to ascertain the relative efficiencies of the hulls of the several ships, either in terms of the midship section or displacement.

In the trials of the *Sydney* and the *Scotland*, the powers exerted to attain the speeds of 10·574 and 8·738 knots respectively, are very nearly in proportion to the cube of those speeds.

In concluding the second notice of "Engineering Precedents," we must clearly distinguish between the facts and the calculations thereon.

With reference to the first they are most acceptable, and, from investigation, we believe they are in the main reliable; the only doubtful point—and it is a very important one—is, how the speeds given were ascertained, for it is evident the slip cannot be known without the *correct* speed of the ship is given.

In a future edition, it is to be hoped the author will give his readers some additional information as to the why and the wherefore of certain calculations in his analysis of the distribution of power; also an explanation of the table, page 109.

"Engineering Precedents" is such a useful class of work that we have been induced to be the more critical in the hope that Mr. Isherwood will continue the series in a corrected form, remembering that he writes for the *practical* engineer, who requires clear proof before accepting results as reliable data for future improvements.

Recent Practice in the Locomotive Engine, &c. By D. K. Clark, C.E., and Zerah Colburn, C.E. Blackie and Son.

We have received Parts V. and VI. of this valuable series. The high character which we have already assigned to this work, when noticing the earlier numbers, is fully maintained in the parts now before us.

In Part V. the results of practice in coal burning are given. A chapter (chapter xi.) is devoted to the "Solution of the Problem of the Complete and Effective Combustion of Coal in Locomotives." Chapter xii. treats of Heat Traps, and commences the division of the work devoted to the "Physiology of the Boiler." Chapter xiii. treats of Safety Valves, and taken as a continuation of the same subject in "Railway Machinery," completes it to the present time.

The division of the work devoted to the "Engine," commences with "Details of the Piston and other Parts;" and chapter ii. enters upon the "Working Dimensions and Arrangements of Engines."

Division II. treats of "American Locomotives," and introduces Mr. Zerah Colburn.

The Carpenters' and Joiners' Assistant. Blackie and Son.

We have on previous occasions referred, in the highest terms of commendation, to the very admirable specimens of Copper-plate Engraving which illustrate this work: they are principally executed by Mr. W. J. Lowry and Mr. W. A. Beever. The textual matter, too, is admirably selected for its practical value to the student in architecture and constructive carpentry, &c.

A Discourse on the Study of Science in its Relations to Individuals and Society. By Henry Hennessy, F.R.S., M.R.I.A., &c. W. B. Kelly, Dublin; and Simpkin, Marshall, and Co., London.

In the fifty pages devoted by the author to this subject, Professor Hennessy combats certain views, which have been so oft expressed, by sections entertaining religious views as to the prejudicial influence exercised on mental development by the cultivation of the mathematical and physical sciences; and he, in an enlightened and truly philosophical spirit, succeeds in triumphantly vindicating the position which the mathematical and physical sciences should occupy in a comprehensive system of education. The pamphlet must be read that the views and arguments of the author may be thoroughly appreciated.

Sketch of the Civil Engineering of North America. By David Stevenson, F.R.S.E., &c. John Weale, London. Second Edition, 1859.

This work, which is doubtless already pretty well known to most of our readers, contains many valuable additions, and will be found by the student a handy book of reference, whilst it forms a useful addition to Mr. Weale's already very valuable series of cheap scientific works.

The Truck System: a Book for Masters and Workmen. By David Bailey. London: Frederick Pitman. 1859.

About twenty pages of closely printed matter are devoted to the exposure of this baneful system, which is still pursued in some districts, to the great disgrace of our manufacturers and employers of labour, and to the serious injury and damage of the employed. Such works as these cannot be too widely circulated, or too carefully read and seriously considered.

The Physiology of Common Life. By George Henry Lewis. London and Edinburgh: W. Blackwood and Sons.

This is the first of a series of tracts upon this interesting subject, and is devoted to the consideration of "Hunger and Thirst." Judging only by the first number, we may recommend the series to our readers as well worthy of their study; and as it is stated that the series will be published in monthly numbers, price 6d. each, it is scarcely necessary to add more in recommendation of the "Physiology of Common Life."

The Problem, Squaring the Circle Solved; or the True Circumference and Area of the Circle Discovered. By James Smith. London: Longmans; Liverpool: Howell. 1859.

The writer, if for nothing else, deserves credit for his devotion to the subject treated of, and for his persevering application to a series of practical and experimental processes for discovering that for which he has laboured.

LIST OF NEW BOOKS AND NEW EDITIONS OF BOOKS.

CAMERON (P.)—The Variation and Deviation of the Compass rectified by Azimuth and Altitude Tables, from the Equator to the Latitude of Eighty Degrees; also by the Azimuth and Altitude Tables are found in the true Position of a Ship at Sea, the Error of the Chronometer and the Longitude; likewise a Treatise on Magnetism and the Deviation of the Compass in Iron Ships, and the Method of Observing and Correcting them by Magnets. 8vo, pp. 90, cloth, 10s. 6d. (Philip).

SCHOFFERN (J.)—Projectile Weapons of War and Explosive Compounds; including some New Resources of Warfare, with especial reference to Rifled Ordnance in their chief known varieties; with the authenticated Weight, Measurement, and Mode of Construction of Armstrong's Wrought-iron Breech-loading Guns; together with an Account of their Shells and Fuses. Illustrated, 4th edition, post 8vo, pp. 378, cloth, 9s. 6d. (Longman.)

Also, a Supplement to the above, entitled, NEW RESOURCES OF WARFARE. Post 8vo, pp. 80, cloth, 2s. (Longman.)

STEVENSON (T.)—Lighthouse Illumination; being a Description of the Holophotal System, and Azimuthal Condensing, and Apparent Lights. With other improvements. 8vo, pp. 122, boards, 7s. 6d. (Weale.)

KNIGHT (C.)—English Cyclopœdia of Arts and Sciences. Vol. 1, 4to, pp. 1006, cloth, 12s. (Bradbury and Evans.)

FLEMING (J. G.)—A Series of Outline Maps; with Illustrations of the Mariners Compass and Solar System. 4to, half-bound, 4s. 6d. (Groombridge.)

JAMES (W.)—The Naval History of Great Britain from 1793 to the Accession of George IV. Vol. 1, 12mo, pp. 510, cloth, 5s. (Bentley.)

BROWN (J. H.)—Mercantile Navy List, 1859. 8vo, cloth, 7s. 6d. (Bradbury and Evans.)

CORRESPONDENCE.

[*We do not hold ourselves responsible for the opinions of our Correspondents.*—Ed.]

RIFLE SHOT AND IRON PLATES.

To the Editor of The Artizan.

Sir,—In that interesting portion of your valuable Journal, entitled "Notes and Novelties" for May, under the division of Military Engineering, &c., I noticed a short account of a trial by that indefatigable experimentalist, Capt. Norton, of an iron bolt projected from a gun, for the purpose of piercing iron plates, and that he expects with a steel bolt to penetrate a "forged plate ½ in. thick."

I do not know the bore of his gun nor the quantity of powder used, but I beg to remark, that some few years since when experimenting with a rifle of peculiar construction, with a bore ⅝ in. in diameter, and a *conical lead bullet* propelled by ¾ of a dram of powder, I *regularly* penetrated, with the *greatest ease*, boiler plates 3-16 in. thick, at 60 measured yards.

I have not the slightest doubt but that this principle, *cæteris paribus*, applied to large guns, would, at 1,000 yards, enable me to make an ugly hole in a forged plate 4 in. thick! C. F. T. Y.

London, May 20, 1859.

SUPERHEATED STEAM.

To the Editor of The Artizan.

Sir,—Great discoveries have their drawbacks. Columbus introduced a loathsome disease, and Dr. Haycroft has perpetrated an inflammatory excresence on the steam-engine. We all have our fancies and our hobby-horses, and most of us, in one way or other, ride them to death. We should learn to assist, not to force, Nature; and thus superheated steam, progressively after it, has been expanded.

We appear to neglect the consideration of first principles. Water exists only by the pressure of the atmosphere. By allowing moist steam to expand, in contact with highly heated metal, it becomes superheated, as it is expressed. That there is economy in the adaptation of it in this form appears certain; but engineers, with very few exceptions, have ignored the plan of expanding and, consequently, cooling the steam in its passage between the boiler and cylinder. Nevertheless, in all adaptations and reasonings about superheating steam, let it be clearly understood, in the first place, that clean cast iron, acted upon by pure steam as the heating medium, is a far better conductor than sooty metal, acted upon by dry gases in a smoke-box; and, secondly, it ought to be a *sine qua non*, that the cylindrical portion of the cylinder should be moist—moist enough to do without oil.

On ship-board, and in factories, pure water is a very valuable article; and it could be impregnated with air and lime for drinking purposes. By making the steam cylinder a condenser we shall be killing two birds with one stone—*i.e.*, we should superheat the attenuated steam within, and produce distilled water outside.

Mr. Craddock is right in ignoring the "steam-jacket," when it makes the working parts dry; and if the steam were greatly expanded before it entered the cylinder, the rubbing parts might be too dry. But by heating the covers only of very large cylinders, and cutting off the cylinder from the condenser, the remnant of exhausted steam is not only prevented from entering the condenser, but it is utilized, by making the coldest part of the cylinder both hotter and moister, and these happen to be the working parts; and by cutting off from the condenser one-third of the internal radiation, or loss of heat, may be also husbanded up in the cylinder, which, without the cut-off, would go into the condenser also. It must be allowed that no condensation whatever would take place on the heated covers, which, being dry and clean, would part with nearly ten times less heat into the exhaust steam aud condenser; hence the great utility of heating them. But the main saving would be in cutting off the cylinder from the condenser. These apparently little things and niceties have not been noticed by Mr. Craddock, or any other engineer, notwithstanding they prevent heat from going into the condenser, and render the working parts moist simultaneously, which every practical engineer must see the necessity of.

Some years ago I observed to a well-known sensible engineer, "Why do you use oil?" He poured some oil into his trunk-engine and it instantly increased its speed. "That is the reason why we use oil," was the reply. How great then would be the saving if a constant quantity of pure limpid water were the lubricator!

Let us look to little things, as well as great things—to the transfer of power—to the friction on dry cogs aud dry pistons—to surface condensation and to the improvement of the air-pump—to the safety and economy of copper boilers and strictly tubular boilers attached to surface condensers. Let all these, and other appliances, be aptly connected, then we should be rewarded by a great saving in wear and tear, and fuel, and boiler explosions would be avoided.

The following is more fully explanatory of my views, and I would take it as a great favour if you would find space for it this month.

Henry Pratt

Duke Street, Grosvenor Square, May 23rd, 1859.

Permit me now to reply more fully to the several suggestions and objections advanced in the discussion, namely:—

1st. To the failure of surface condensation; not because Hall failed in the mechanical fittings and arrangement of his condenser, but because an extraordinary effect was produced which, in a few years, destroyed the boiler.

2nd. To the large amount of surface, and to the extra quantity of water required to produce a good vacuum.

3rd. To the comparatively small saving that an extra pound of vacuum would effect.

4th. To forcing the air direct from the double air-pump into the boiler.

5th. To the small amount of surface a plain round, upright copper boiler would furnish for marine engines.

At the period when Hall's surface condenser for marine engines was so highly spoken of in the papers, I was busily engaged in Jamaica erecting a steam flour mill and bakery for the Government contractors, and I well remember something about oil floating on the surface of the water in the boilers which were attached to the surface condenser; and as far as my memory serves me this was considered an advantage, though it might have been one of the chief causes which, in a few years, destroyed the boiler. But oil is not necessary in well-arranged cylinders, and ought never to be used for the pistons and stuffing-boxes, &c. As I remarked to you that copper was not absolutely necessary to form an effective condenser, neither is iron absolutely necessary to form an economical boiler. Mixing the metals anyhow may be injurious or imprudent; but I gravely suspect that the presence of oil in the water and steam, both acting with velocity on the small copper pipes, produced a compound, which caused a corroding action on the iron of the boiler. How long the original distilled water (in the best type of condenser without oil) may be used over and over again without a complete change, or whether the constant replenishing of the boiler with fresh water, for leakages alone, will be sufficient, experience must determine. But as distilled water would be ready at hand, in the arrangement I propose, there would be no difficulty should it be found advisable to replenish the boiler periodically with pure water in lieu of hard water.

As to the type of condenser chosen by Hall, and practically carried out by Mr. Craddock, I decidedly object to it. You will perceive from this paper that moving Craddock's condenser *to and fro*, made a difference of 4 in. of mercury. This accounts for the extra quantity of water you referred to, and which will be so when the steam and condensed water are forced through small pipes, instead of conducting the exhaust steam freely into a large reservoir crammed with pipes for the cooling medium to flow through. In Hall's plan the cooling medium is comparatively still, and does not get mixed without the condenser is agitated. Hence the waste of water you speak of. Whether I was the first to patent, in 1855, this new type of condenser time may prove, but it was conceived ten years ago, when I first saw Craddock's revolving air-surface condenser. Mr. Spencer has adopted this type of condenser, and placed one in a vessel which has been running twelve months, and the year's results have been published in The Artizan. The engineers of the *Adriatic* steam-ship have also adopted it, and they did boast of very great savings. In both these cases the pipes are small and made of copper, but no means are attempted to mix the water. I have contrived a very simple arrangement to effect this, which is very easy of application and novel. The mode of securing the pipes at their ends by elastic washers, bedded on the cast-iron ends of the reservoir, may be exclusive property. This is Mr. Spencer's mode, and he is now using cast-iron ends instead of copper originally; but Mr. Craddock does not mix the metals, and makes metal joinings with cranked pipes.

A good vacuum in any condenser is most important when proper arrangements are made to make the most of the steam; and 1 lb. better vacuum in such a case may be far more useful than several pounds when the steam is permitted to escape in a hotter and denser state from small cylinders.

I now come to the remarks alluded to of forcing air over and over again, direct from the double air-pump, into the boiler. It matters not whether pure attenuated air or vapour is absorbed by the air-pump, for in either case the water will be heated and the air or vapour condensed by the mechanical compression of the pump. If the air may, to a trifling extent, hinder the sudden condensation of the attenuated vapour in the condenser, it may assist in boiling the water, &c. Be this as it may, for low-pressure steam and a good vacuum the original air may be got rid of, and the air which may enter the cylinders through the stuffing-boxes may also be allowed to escape before it enters the boilers should it be found necessary; but which I predict will not be necessary nor injurious except in excess. In moderation it may be beneficial (see provisional specification). But, remember, in all cases, the larger and more effective the air-pump is, the hotter will be the water when it enters the boilers, provided it is applied to the same amount of vacuum. This is an important feature in the arrangement, for it is as it were killing two birds with one stone.

I now direct your serious attention to one of the most important branches of the steam engine—the monster boiler—and which appears to have broken down more than any other part.

It is not a question of surface in the abstract, but also a question of disposition and quality of surface exposed to the fire. For instance; 1 ft. of clean copper surface, exposed to a *vibrating action* of flame, and the immense main body of flame afterwards opposed by a clean copper surface at right angles to the current, may conduct more heat to the water than 10 ft. of surface as arranged in marine multitubular boilers! Nothing can exceed Mr. Craddock's "strictly tubular" upright boiler for steam at 100 lbs. on the inch; but at less than that pressure or heat soot even adheres to these tubes, and might, as in multitubular boilers or common chimneys, take fire. Hence the flame might now and then be seen at the chimney top.

I have now, to the best of my ability, replied to your remarks and criticisms. But before I close this communication, I beg to remind you of the late criticisms of the Editor of "The Engineer" on the doings in the Admiralty, and on the superheating apparatus of Messrs. Penn and Sons; also to the impressive notice in The Artizan for this month, from which I have extracted the following:—

"A full discussion, by competent parties, upon the nature of the advantages of superheated steam, and of the best means of realizing them in practice, would now be of great value to the world."—The Engineer.

[*Note.*—I humbly submit for your consideration the principle of superheating steam progressively *after* it has expanded].

"The steam engineering of 1859 is in a most defective condition. The astonishment expressed at the economy resulting from the use of superheated steam indicates, only too truly, how far we have departed in practice from first principles. It is a matter of serious doubt if an improvement that is based on the existence of a previous defect is the best of the kind. . . . Boilers, engines, condensers, must all be greatly improved; for each has its peculiar source of waste, the sum total of which is well known to be considerable."—The Artizan.

What an amount of skill and labour these salutary truths must entail on first class engineers! For it is not merely the necessary improvements in "boilers, engines, and condensers," but the apt connection of these parts, associated together by the bond of harmony which can alone produce a sound symmetrical steam engine.

For, as Pope says,

"In wit, as nature, what affects our hearts
Is not th' exactness of peculiar parts:
'Tis not a lip or cheek we beauty call,
But the joint force and full result of all."

Henry Pratt.

NOTICES TO CORRESPONDENTS.

J. T. M.—Your communication was received too late last month to enable a reply to be given. Too much space would be required to reply to your inquiry usefully, but a reference to the works of Mr. John Bourne upon the Steam Engine, the Screw Propeller, &c., will afford you all the information you ask, and enable you, with a little trouble, to adapt the proportions therein given, to any special case. We have partly prepared a paper upon the subject; but, as it will occupy four or five pages, we are obliged to defer its publication for a month or two. The last edition of D. K. Clark's work upon Railway Machinery, published by Blackie and Sons, will give you the best information relative to slide valves for high pressure engines; the last edition of Bourne's Catechism will also be found useful.

A. R. C. (Liverpool.)—Apply by letter to T. Lloyd, Esq., Chief Engineer and Inspector of Machinery, 22, New-street, Spring-gardens, London, stating age, previous experience, &c. Your application would doubtless meet with immediate attention.

D. C. (Old Subscriber), Salford.—Many thanks for your communication and the enclosure; they will be used next month.

C. E. F.—In reply to your last letter, without date, the information was sent by post, as promised. The first patent was dated 22nd October, 1832, and specified April 22nd, 1833. The specification of Muntz's patent for sheathing for ships may be had at the Great Seal Patent Office, 25, Southampton Buildings, price 3d. The second patent for the manufacture of bolts and other "ship's fastenings," dated 17th December, 1832, may likewise be had at the same place, price 3d.; it was specified April 24th, 1833. They both relate to the mixture of 60 per cent. of best selected copper and 40 per cent of best foreign zinc; the mixture thus produced was rolled into the required shape. Another patent was obtained, dated October 15th, 1846, the specification whereof was dated April 15th, 1847. This patent was for manufacture of metal-plates for sheathing of ships; the composition of the metals being therein varied as follows:—Fifty-six parts of copper, forty and three-quarter parts of zinc, and three and a quarter parts of lead. This mixture is rolled hot into sheets. These are the Muntz patents.

J. M. H. (Cork.)—We have not recently heard any complaints respecting the delivery of The Artizan.

J. C. C.—The Mr. Waddell who designed a Marine Engine Governor which was to operate upon the Throttle valve or valves by the greater or lesser immersion of the stern of a screw steamship, or the midship portion of a paddle-ship, is the same who communicated through Mr. Charles Beyer, a Paper on an "Improved packing for the Slide valves of Marine Engines," read at the meeting at the Institution of Mechanical Engineers, 30th April, 1856.

J. T. P., E. B., J. O., and C.—Received too late for attention this month; but, on forwarding your addresses, you will be communicated with by post.

C. Johnston, B. F. (Manchester), and T. E. (Hull).—The Engineer-in-Chief of the Peninsular and Oriental Steam Company, Mr. Andrew Lamb, was the first to apply steam for extinguishing fires on board steam ships. We believe the *Hindostan* was fitted in 1842, and the *Bentinck*, in 1843, with an arrangement of steam-pipes for this purpose, throughout the engine, boiler, and bunker spaces. The *Jupiter* was fitted in 1849, throughout the entire ship, with steam-pipes and cocks. Immediately after the destruction of the *Amazon*, on the 4th February, 1852, the system was applied generally throughout the fleet of the Peninsular and Oriental Steam Company.

J. C.—Apply to J. Weale, High Holborn; Spon Bucklersbury; Hebert, Cheapside; or to Batsford, bookseller, Holborn, as they are the most likely persons to obtain the number you require.

R. (Havre).—The individual in question has "a Bee in his Bonnet."

C. P. and J. B.—Mr. J. F. Spencer, has in our opinion, been most successful in the construction and application of surface condensers.

Herbert S.—We should be sorry to undertake a long sea voyage with the description of boiler referred to. It is all very well whilst the fresh water apparatus continues to work satisfactorily; but should it fail, and certainly provision should be made for such a contingency, such a boiler would not last one week with salt water.

P.—The cause of the inconvenience from hot bearings is, too frequently, inattention. We think the metal employed for your crank-pin bearings is, probably, unsuited for the purpose. You should send home for new brasses. (Your letter was received 26th May.) We advise you to attach a clip to the cap and secure the cold water jet pipe or nozzle to it, leaving the vulcanized India-rubber tube long enough to admit of the rotation of the crank, and thus avoid the necessity for one or two hands being employed to swill the bearings when hot.

"Peter Schlemeil."—Suggest to your captain to have down-cast pipes or wind-tubes about 14 in. diameter, with moveable bell mouths, fitted so as to extend to the lowest convenient line in the boiler alleys at the extreme ends thereof; increase the air-space around the funnels, and the height of the casings above the deck. You do not state whether your furnace-doors are pierced or solid; if the latter, drill a number of holes through them not exceeding ½ in. in diameter. You will find these alterations very materially reduce the temperature of the stoke-hole. Let us know the result.

P. (Jamaica).—How's Patent Salinometers are the best. You are in error. Mr. John Penn was not the *inventor* of the trunk engine, with which, however, his name is generally associated; the patent referred to was for an arrangement of valve-gearing. We cannot spare space to relate the origin of the popular notion which is current respecting the association of Messrs. Penn and Sons' name with the trunk engines, but some day or other we may have the opportunity of doing so. Mr. Andrew Lamb, the engineer of the Peninsular and Oriental Steam Navigation Company, was the very first who introduced surface blow off in sea-going boilers, and we are glad to have this opportunity of stating the fact, and giving credit where credit is due; for we fear that the circumstance is not at all known, and possibly the plan may be ascribed to others, or the credit might hereafter be appropriated.

J. C. (Bombay).—Your inquiry is answered in the present number. You will see that 2¼ lbs. of coal per indicated H.P. per hour *has* been obtained, practically, and as an every day consumption during actual performance. The coals sent from England, by the time they reach you are much deteriorated in value as fuel for generating steam. Will you favour us with the results of your practical experience as to the respective values of Welsh and Newcastle steam coals, particularly as to the small, resulting from the breaking down consequent upon shipment and a long sea voyage.

P. C., Q., and others, must stand over until next month.

B. R., J. P. L., and Alpha.—Send addresses—(received 26th May).

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c.

UNDER this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.—ED.

ENGLISH ARTIZANS ABROAD.—The *Gazette* of the 26th April ult. warns, by notice from the Foreign office, all persons who accept engagements for employment in foreign countries as railway labourers, miners, engineers, stokers, and firemen, or in any other capacity, that they are not considered by Government to be entitled to relief as distressed British subjects, or to be sent back to England at the public expense: and such persons are warned that Her Majesty's consuls abroad have received orders not to afford relief in such cases.

THE POLYTECHNIC STAIRCASE.—In the Court of Queen's Bench, May 7th ult., Lord Campbell refused a rule for a new trial, in the case of Brazier *v.* the Polytechnic Institution. The defendants had obtained a rule nisi (conditional rule) to arrest judgment, and for a new trial on the alleged ground of the verdict being against the evidence, and on other (technical) points. In the course of the arguments the defendants' counsel stated that about fifty actions had been brought against defendants, all arising out of the same accident.

EFFLUVIA FROM OXALIC-ACID WORKS.—ALLEGED PUBLIC NUISANCE.—At the Thames Police-office, 2nd May ult., the [adjourned] hearing of the summons, recently issued against Pento Perez, the proprietor of extensive chemical works in Limehouse, at the instance of the local inspector of nuisances, and the medical officer of the Limehouse Board of Works, was resumed before Mr. Yardley. The prosecution had been instituted on the complaint of the surrounding neighbourhood on account of the noxious vapours that proceeded from the works to the injury of the health of the inhabitants. After hearing the scientific evidence produced, the magistrate said he was reluctant to shut up the defendant's premises and stop his business, and consented to adjourn the case on condition of the defendant putting himself in the hands of Mr. Taylor and Mr. Brande, who would superintend the adoption of a plan, suggested by Mr. Blundell, of Limehouse, a member of the Board of Works, for destroying the poisonous vapours before they could mingle with the atmosphere. On the part of the defendant, a document (memorandum) was then put in, signed Alfred S. Taylor, M.D., F.R.S., and William Thomas Brande, F.R.S., dated London, May 2, 1859, to the effect that Mr. Blundell's apparatus (now erecting in the defendant's works), would, in all probability, prevent the nuisance to the neighbourhood which had hitherto arisen from the escape of the noxious effluvia in question. Whereupon the magistrate consented to the application for adjournment of the case for three months for the purpose of effectually testing the efficacy of the new effluvia-destroying apparatus.

LOSS OF THE SCREW-STEAMER "GENERAL WILLIAMS."—The official inquiry into the cause of this disaster (for particulars of which see our last Number's "Notes and Novelties") closed on the 14th May ult. The court, considering that the captain could have done more to ascertain the cause of the ship's letting water, as also that with a little more attention he could have saved the ship's papers, awarded the captain to pay the costs of the inquiry, as far as regarded witnesses: moreover, the Court would report to the Board of Trade their view of the evidence produced. In this report, since published, the loss of the vessel is ascribed to improper loading. This not being in consequence of any wrongful act or default of the captain, his certificate was returned to him.

BOILER EXPLOSIONS.—INEFFICIENT STEAM-GAUGES.—On the 11th May ult. the adjourned coroner's inquest relative to the fatal boiler explosion at Messrs. Learoyd and Co.'s Woollen Mills, Huddersfield, on the 28th April ult., declared that the explosion was "caused by over-pressure," adding a rider to the verdict—1st. Condemning the act by which the boiler had been raised from a 30 lb. to a 50 lb. pressure, without a proper and efficient examination. 2nd. Blame to the inspector of the Huddersfield Boiler Association for having, on the day previous to the explosion, shifted the ball to the end of the lever, thereby increasing the pressure, without having previously made an accurate internal examination of the boiler, and without having a steam-gauge of sufficient capacity to indicate the pressure. The jury concluded by calling the immediate attention of the mill-owners in the neighbourhood to the present very defective practice with regard to the examination of steam-boilers.

THE HOUNSLOW GUNPOWDER MILL EXPLOSION.—The coroner's jury, at the (for third time) adjourned inquest held to investigate the circumstances of this disastrous affair, returned (17th May ult.) a special verdict to the effect, that the deceased (Thomas Albone) was killed by the explosion of a large quantity of gunpowder at the mills belonging to Messrs. Curtis and Harvey, but by what means the explosion took place there was no evidence to prove—adding, that the works in question had, in the jurors' opinion, "been conducted in an exceedingly loose and dangerous manner; and that the safety of the workmen engaged in such establishments, and of the public generally, requires the immediate enactment of a law for subjecting all gunpowder manufacturers to the strongest supervision of Government inspection and control, with a view to the invariable adoption of the precautions and recommendations similar to those contained in Dr. Thompson's report. The jury also noticed that of late years the works in question have been greatly, and, as they believe, unlawfully increased; and that gunpowder has been kept in such vast quantities as to be attended with danger to workpeople employed therein, as well as to the inhabitants of the surrounding neighbourhood."

DEFECTIVE COLLIERY ENGINES, AND LIABILITY OF PIT-OWNERS.—At the Wern Colliery, Llantrissant, South Wales, as three men were (night of 12th May ult.) being lowered to their work, the engine got out of gear, and the "carriage" ran down with great speed, and became unmanageable. A chain got loose from the machinery, and fell to the bottom of the shaft, killing a collier. At the coroner's inquest, the Government Inspector of Mines for the district stated that he had inspected the machinery of the colliery in November, 1856, and then pointed out to the engineer certain defects. He also wrote a letter to the proprietors, warning them that they were liable to penalties for not observing the provisions of the Local Mines Inspection Act. He had inspected the machinery since the accident, and found no break attached to the chain used for raising and lowering persons; neither was there a proper indicator to show the position of the load in the shaft, as required by the sixth general rule of the 18th and 19th Victoria, cap. 108, sec. 4. If there had been a break to hold the carriage in the shaft, the life of the deceased would have been saved. The jury returned a verdict of manslaughter against the proprietors; and the coroner forthwith issued his warrant for their committal for trial at the next assizes. Subsequently, however, under the powers of a recent statute, he admitted them to bail.

BREACHES (BY MILL-OWNERS) OF THE FACTORY ACT.—At the West Riding Court, at Bradford, 21st May ult., no less than fifty-four informations against various mill-owners, for breaches of the Factory Act, were heard. Some of the cases turned on the alleged violation of the 8th section, in allowing several adult persons to clean their looms during dinner-hour—said to be a common practice. As the cleaning of the frames was not necessary to the due carrying on of the manufacturing processes, the Bench held that the defendants had a beneficial interest in the machinery being cleaned during the dinner-hour, and were therefore guilty of the offence. Each defendant was fined on several informations.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

WE have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "18, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

THE GIGANTIC STEAM CRANE, at Portsmouth Dockyard, was severely tested (6th May ult.) by the slinging of a quantity of pig-iron ballast, exceeding 60 tons. The crane was worked by an 8 H.P. engine (Taylor's), the crane by Messrs. Browne. The deflection represented $5\frac{3}{4}$ in. After the weight was released, it sprang back to $5\frac{1}{4}$ in. leaving the $\frac{1}{2}$ in. to account for the enormous strain. Test considered highly satisfactory.

CONTRABAND (?) MACHINERY OF WAR.—As one of the earliest events of the present Italian war, which (independently of the already realised partial suspension of railroads, the cutting off of telegraph communication, destruction of bridges, &c.) appears likely to affect the arts and manufactures of this country, we may notice the recent Imperial decree of the Emperor of the French, dated 30th April, 1859, the receipt of which is officially acknowledged by our Government, 6th May ult., prohibiting, without a special permit from the French Government, the exportation, *transit*, or re-exportation on bond of (amongst other articles) "sailing and steam vessels, MACHINERY and PARTS OF MACHINES applicable to navigation, spars and rigging of ships, and all other raw or manufactured articles used for naval and military purposes."

OF COAL, CINDERS, AND CULM, the total quantity exported from the United Kingdom to Foreign Countries, and British Settlements abroad in the year 1858, amounted to 6,529,483 tons: value, £3,045,434. France took 1,325,330 tons of our coal last year, being, by far, our largest customer for that commodity; and 1,279,133 tons in 1857. 26,754 tons of coal were brought into the port of London in the year 1858.

OF PATENT FUEL, in same period, 67,645 tons were exported, worth £43,313, and 19,226 tons were brought into the port of London.

THE TOTAL QUANTITY OF COAL exported from British ports in April last, was 1,178,148 tons, being an increase of 81,304 tons, as compared with the exports in April, 1858.

STEAM MACHINERY exported from England in the month of March for the last three years:—In March, 1857, £63,215; in March, 1858, £72,000; in March, 1859, £46,444.

OTHER MACHINERY—£175,613, £140,587, £171,222, in March of the three years respectively.

THE STEAM-TRANSPORT "DEE," which recently left Woolwich for Portsmouth, laden with steam machinery, is understood to be the only serviceable ship of that class at present in the Royal Navy.

VEGETABLE WAX, a new produce from Japan, has recently been introduced into this country as an article of commerce. The first cargo was brought (lately) into the London Docks by the American ship *Florence*.

REDL'S CONE SIGNALS are, by direction of the Lords of the Admiralty, to be supplied for the use of the Channel Fleet: preparations are being made, accordingly, in the Devonport Dockyard.

MARITIME COMMERCE OF FRANCE.—The recent official return shows that the number of vessels which entered the French ports in the first three months of the present year, was 2,067 French and 3,063 Foreign; the tonnage of the whole being 827,933; and the number which sailed was 2,060 French, and 2,576 Foreign, with a tonnage of 708,093.

FLAX-MAKING MACHINERY, on an extensive scale, is being sent out to the Punjab, a company having been formed for the purpose of procuring a supply of flax from India; the raw material so largely in demand for our factories at home having been hitherto chiefly obtained from Ireland and the continent of Europe. The object of the new undertaking is to purchase India-grown flax from the zemindars, and through their agent to have it sent home for disposal.

THE EXTENSIVE SUGAR REFINERY of Messrs. Tripp, Medge and Co., Quay Head, Bristol, was (30th April ult.) destroyed by fire. Greater part of the manufactured stock, together with 1,000 tons of charcoal (worth £15 per ton), the whole of the cylinders, and other costly machines, and the buildings (an immense pile, ranging to a height of ten stories), entirely destroyed.

MACHINERY, &c., FOR RUSSIA.—From Newcastle-on-Tyne we learn that, owing to the disturbed state of affairs, the Russian Government has lately countermanded an extensive order for locomotives and machinery; and, further, that a large firm in South Shields, has been obliged to pay off 200 or 300 hands.

THE SILK AND CALICO PRINTING WORKS of Messrs. A. Littler, at Merton Abbey, Surrey, were nearly destroyed by fire on the morning of the 5th May ult. Two timber buildings consumed, and two printing shops very considerably damaged. Origin of the fire unknown.

A BAND SAW of the extraordinary length of 43 ft., and $6\frac{1}{2}$ in. broad, made at 15th wire gauge, has recently been manufactured and exhibited by Messrs. Atkin and Peace, of Celtic Works, Sheffield. It is for the purpose of cutting logs of unusual thickness, with a saving in labour and material.

A NEW PILE-DRIVING MACHINE has been patented by W. Toshach, of the Railway Works, Bristol Road, Gloucester, engineer. The advantage alleged to be gained by this machine, is the continuous motion of an endless chain, carrying up the hammer with it by means of projecting pins in the chain catching into a fork attached to the former, which picks up the hammer immediately after it falls, released by the self-acting withdrawal of the projecting pins, on the pile, thereby saving the time usually taken up in pulling down "nippers" and slack-chain.

THE GREAT WESTMINSTER CLOCK is still, according to the recent official report from Mr. Denison, waiting for the plasterers and bricklayers. The total cost of the clock up to the present time, has been £20,307; and it is estimated that a further sum of £1,750 will be required before the work is complete. The cost of the clock itself, and the dials, has been £8,279 and of the bells, £5,966.

SPIRAL HEAT-DIFFUSERS, in the shape of twisted plates of metal to be introduced into the tubes of steam-boilers, have been recently suggested as producing, it is said, a change of circulation of the heated products of combustion, in their passage through the tubes, and arresting a large measure of it, transmitting it to the water, and converting into working steam that equivalent which, without these appliances, would escape through the flues and be lost.

The recent Destruction by Fire of the extensive Sugar Refinery at Bristol (see "Notes and Novelties" for last month) has entailed heavy losses to several of the local and metropolitan insurance offices, with whom policies had been effected on the building, stock, and plant, to the aggregate amount of £63,500.

The Lincoln Post Office was on the afternoon of the 18th May ult. destroyed by fire. The damage caused is estimated at several thousand pounds.

A Hazardous Cargo.—On the 9th May ult., the *Benjamin Boyd* and the *Queen* commenced shipping war stores from Woolwich for Malta and Corfu, having built magazines capable of containing 300 tons (!) of powder, which they had orders to embark from the river hulks off the Arsenal.

The Disputes in the Ribbon Trade, at Coventry, still continue. The majority of the weavers are resolved to insist upon maintaining the "piece" system; and at several meetings lately held, levies for the support of the weavers who may be thrown out of work have been agreed to.

The Great "North of India" Tramroad, originally to have been carried out by a company, is now to be taken in hand by the Government itself. Official notice of this decision having been given to the Company, the Directors have proceeded to divide the assets in hand, amounting to 1s. 3d. per share, and to wind up the affairs of the proposed undertaking.

The Extensive Tar Distillery (Bethell's), at East Greenwich, has been destroyed by fire, commencing in a still, where about 6,000 gallons of tar were being refined; the flames spread to another still, containing 4,000 gallons, so that 10,000 gallons became ignited. The fire originated from the leakage of a still, whereby the tar flowed into the furnace beneath.

Gunpowder Mill Explosion.—At the Government-mills, at Waltham, only one fatal accident had taken place in forty-eight years. The average population, subject to danger from explosion by gunpowder-mills, is estimated, in the thirteen mills in England, the six in Ireland, and the one in Scotland (in all, 20 establishments) at one thousand persons a year.—*Dr. Thompson's evidence.*

Another Gunpowder Explosion, or rather a succession of explosions, at the Hounslow Mills, occurred at a quarter-past 11 o'clock, on the 17th May ult. This time, the accident happened in the "incorporating mills," four in number, situate near the engine-house, in one line of building, through which a shaft runs, that turns four pairs of immense iron-edge runners, used for grinding the various articles together, of which the powder is composed; viz., saltpetre, charcoal, sulphur, kept continually damp, and, in this state called "green charges." The whole of these mills are destroyed; and one workman dangerously injured.

The Proposed Monument to the late George Stephenson, is, by resolution of the subscribers, held in the Council Chamber, Newcastle-upon-Tyne, 11th May ult., to be a statue by Mr. Lough, a Newcastle man; the monument to be erected on a triangular piece of ground at the junction of Westgate and Neville Street, and nearly opposite to the Central Station; subject to the grant of that site by the Corporation, whose consent is not doubted.

The Diving Apparatus is being used in bringing up various articles of value belonging to the ill-fated emigrant ship *Pomona*, recently lost on the Blackwater Bank, near Wexford, Ireland. On the 14th May ult., a steam-tug and lighters arrived thither from Liverpool with the necessary diving-apparatus; and proceedings were commenced on the 17th, the divers first clearing away the rigging, &c., impeding access to the hatchways. Since then the divers have been successfully engaged in bringing up various articles belonging to the ship. One of them came across three bodies, which he disentangled from the wreck, and they floated to the surface.

Improvement in Gunpowder Mills.—Since the late disastrous explosion at the Hounslow mills, and in order, as far as possible, to prevent the recurrence of a similar catastrophe, the premises have been reconstructed upon a different principle; with the addition of a "traverse," or bank of earth, 20 ft. thick, expressly made for the protection of the men employed in working the hydraulic press; thus isolating the most dangerous portion of the works requisite in the perilous operations of the manufacture of gunpowder.

At Boston, U.S., an institution is about to be established upon the plan of the Parisian "Conservatoire des Arts et Métiers," to comprise a Museum of Practical Metallurgy, Agriculture, and the Mechanical Arts.

As a Substitute for Red-lead, hitherto extensively used in paying the bottoms of iron steamers, and the corrosive qualities of which covering have recently been pointed out, Mr. John Scott Russell proposes his [patented] coating of pulverised and subsequently burnished copper, over a first coating of tar, pitch, or other varnish; and Dr. Collyer employs, for the same purpose, the relatively cheaper and [as alleged] equally efficacious metals—zinc, lead, and tin.

TELEGRAPH ENGINEERING, &c.

Cagliari and Malta.—This submarine cable has not yet been put into working order. The *Elba*, which, it was said, would be employed in this service, has reached Malta, and left on the 3rd May ult. for Syra to lay down the new cable between Candia and Alexandria. Mr. Leddell, the engineer and contractor, and his staff, arrived from Marseilles on the 4th, a few hours too late to overtake the *Elba*; whereupon they chartered the *Dragon*, a small harbour tug, in which they left for Syra on the 8th May ult.

Between Corfu and Malta, the submarine telegraph was kept constantly working from 8 a.m. to 5 p.m. on Sunday, 1st May ult., in receiving and transmitting messages between the Lord High Commissioner of the Ionian Islands and Vice-Admiral Fanshawe, the naval Commander-in-Chief in the Mediterranean.

England to Gibraltar, and thence to Malta.—The *Firebrand* steamer was (9th May ult.) directed, by Admiralty order, to be got ready forthwith, in order to survey the route, and take soundings from England to Gibraltar, and from thence to Malta, including the skirts of the Bay of Biscay, with a view to laying down a submarine electric telegraph for the service of the Government at a future period. The *Firebrand*, temporarily commissioned for *this* service (?), has received her armament from the Royal Arsenal, consisting of four 10 in. 84 cwt. 98-pounder, and two 95 cwt. 68-pounder pivot guns; and she is now (19th May) shipping a large quantity of shot and shell!

Spain and Portugal.—The submarine cable, which, traversing the Mino at Tuy, will place Spain in direct communication with Lisbon, is being actively proceeded with. There will, then, be four wires of communication between the two countries—two by Gallicia, and two by Estremadura.

The Progress of the Telegraph in France is signalised by the recent and remarkable extension of the various telegraphic lines. There are, at present (in France), near 200 (secret) offices (*Bureaux de Télégraphie privée*) managed by state employés. A considerable number of Bureaux, of second-rate importance, are conducted by persons in the employ of the various railway companies.

The Receipts, in the various (state telegraph) stations during the year 1858, exceeded 3,500,000 fr. In this amount, the Paris Bureaux figure for 1,500,000 fr.

Calcutta and London are, it appears, about to be connected by an electric wire—a portion of the cable, 900 miles in length, having, according to the "South African Commercial Advertiser," already reached Table Bay; thus, in the course of a few months, the capitals of India and England will be only a few hours apart, in point of time.

St. Petersburg to the River Amoor.—Recent advices from St. Petersburg assert that this gigantic line of telegraph from that capital to the far-off mouth of the River Amoor, is in process of accomplishment.

The Red Sea Telegraphic Cable, in first-rate order and gutta-percha firm, arrived at Aden on the 6th April ult., by the *Imperador*, which left for Suez the day following. The *Imperatrix* hourly expected, as also the Cyclops from Bombay, to pilot the vessels in paying out the cable. The other stations selected are Suez, Cosseir, Perim, and Sualten: and huts have been despatched from Suez for the temporary accommodation of the working telegraphists. On the 19th April ult., the portion of cable arrived at Suez.

RAILWAYS, &c.

The Cornwall Railway, crossing as it does the numerous valleys and hills of an uneven county, presents a, perhaps unprecedented, series of engineering difficulties, the last and most formidable of which, that of the successful completion of the Saltash bridge, we elsewhere notice. In a distance of 60 miles there are no less than seven tunnels, and upwards of 5 miles of viaducts; besides cuttings, curves, and gradients almost innumerable. Amongst the latter (next to the Saltash one), the most interesting is that of the apparently frail, but, in reality, marvellously substantial wood-work structure thrown over the Coombe Lake.

On the Eastern Union Line, the Woodbridge extension, now nearly ready for opening, will shorten the distance from London to Lowestoft and Yarmouth by about 30 miles.

Indian Lines.—The construction of the Nagpore Branch (263 miles) of the Great Indian Peninsular Railway, has been let to Messrs. Lee, Alton, and Watson, at present on the staff of Mr. Joseph Bray. This extensive undertaking is to be commenced in September next, to be completed by the 25th of March, 1863.

The London-Bridge and Charing-Cross Railway Bill is to be opposed in the new Parliament by the Metropolitan Board of Works, who, at their weekly meeting on the 13th May ult., adopted a report containing an amended Bill, with clauses inserted for protecting the interests of the Board, and recommending that a petition be presented to the House of Lords against the first-mentioned Bill, in order to give the Board a *locus standi* to watch its progress.

Eastern [of France].—The Vincennes line is to terminate at the Place de la Bastille, at the angle of the Rue de Charenton, where a new platform, &c., are being erected. At present, this line is 17 kilometres in length (completed). The chief engineering works are—the bridge inside Paris, under the Rue de Charenton; that of the Rue de Picpus; the Reiully Tunnel, 162 metres in length; the bridge at the Barrière du Trône; the passage under the Ceinture Railway; the Saint-Mandé Tunnel; that of Vincennes, 400 metres in length; the bridge over the Saint-Maur canal; and the viaduct of Saint Maurice. The several stations are to be at the Barrière Picpus, Saint-Mandé, Vincennes, Fontenay, Nogent-sur-Marne, Joinville-le-Pont, Saint-Maur-les-Fossés, Parc de Saint-Maur Champigny, and La Varenne.

For Railroads and other Public Works in India, the gross total amount of money raised, or to be raised, on State-guarantee of interest (generally 5 per cent.), is £32,314,300. Portion of this sum, paid up on 28th February last, £20,869,016.

Of Railways in Italy, there are, at present, according to the "Annuario Statistico Italiano," for 1858, 1,757 kilometres already completed; 2,339 in course of construction; and 634 for which concessions have been granted.

The Sub-Alpine [Mont Cenis] Tunnel is in full progress. Up to March last, 357,000 fr. had been spent by the Turin Exchequer on the works. At the Savoy side, 255 metres have been pierced; on the Piedmont end, 358. By 1860, one-third of the whole work, viz., 3,018 metres (near upon 2 miles) will have been completed.

Western [of Switzerland]—Lausanne and Villeneux—The contracts for the earthwork and buildings for this line have been adjudicated; the three lots, namely, Lausanne-Culley, Cully-Vevey, and Vevey-Villeneuve, estimated at a total of 5,800,000 fr. were adjudged to Messrs. Arnaud, Paul and Co.

Hainault and Flanders Line.—After five months' incessant labour, the driving through of the tunnel on this line, between Renaix and Nunkerke, has been successfully accomplished. The masonry work, for lining and supporting the interior, is being pushed on with great activity. Up to the present time, no accident of a serious nature has occurred to delay the progress of this, in an engineering sense, most arduous undertaking.

Mediterranean Lines.—The opening of the railway from Aubagne to Toulon, which had been fixed for the 3rd May ult., has been indefinitely postponed: placards to this effect having been posted on the walls of Marseilles. The local journals remark, that under present circumstances, the reservation of this line for the service of the State might naturally be expected.

At Pontecurone [Piedmont], the railway and telegraph (according to the local accounts) were, May 6th ult., wantonly destroyed by the Austrians, previously to their evacuating the place: the station-house was knocked to pieces, and all the harm possible done.

Spanish Lines.—From Alcasar to Ciudad (which latter branches on the Alicante Railway) the line has been sub-let by the Madrid and Saragossa Railway. This will be an addition of 112 kilomotres to the main Spanish system, taking the lead of the Andalusian and Portugese lines.

The Ciudad Real Railway had a subvention of about 21 millions of rêals—a portion of the credit of 2 milliards of rèals (500 millions of francs)—recently voted by the Cortes to the Ministry of Public Works.

The Section of the Madrid and Quadalaxara Line, which has been open for some time past for goods' traffic, will shortly be inaugurated, when the journey from San Isodro to Madrid, and back again, will be performable on the same day.

The Construction of Six Railway Postal Sorting Vans, for the Mediterranean Spanish lines, was advertised, for a *second* time, by the Companies; but, strange to say, not one contractor offered.

The Great Northern and Western [of Ireland] Railway traffic is, for the future, to be worked by the Midland Great Western Railway Company of Ireland.

The Sardinian Railways, in 1848, comprised only 17 kilometres of line; at present, the length opened for traffic is 933 kilometres: the first lines (which were constructed by the State) were those of Alessandria to Arona, and Turin to Genoa—the last being one of the most difficult lines in Europe, more especially as regards the portion from Genoa to Novi. Cost of construction and rolling-stock, 135,720,000 fr., or more than 504,000 fr. per kilometre (5-8ths of a mile) for a length of 270 kilometres. The Turin and Genoa Line was opened 6th December, 1853—the section from Alessandria to Novara on 9th July, 1854—that of Novara to Arona (Lago Maggiore) in 1855. The station for the junction of the Lombardo-Venetian, with the Sardinian Railways, was (up to the present war-like interruption) settled to be at Trecarti; the works so forward that, in a few weeks, a locomotive would be able to run over.

The Danube and Black Sea [Kustendjie] Railway is advancing—the whole of the land required for the line having been given over to the Company. The earthworks have been commenced, and are expected to be completed by August next, enabling the whole line to be opened for traffic in the ensuing spring.

The Railway from Calais to Boulogne is settled upon; the works are to be commenced forthwith, and are to be carried on without interruption to completion. The original tracing is to be adhered to, and, in two years' time, it is confidently stated the inauguration of this branch will take place.

The Simplon Line, for the whole distance up to Martigny, is nearly finished; a trial trip has already been made, on the portion between Le Bouveret and Saint Maurice; and the inauguration of the tunnel, at the latter place, is announced.

The Southern [of Austria] Railway, up to the late war events, was proceeding actively. The "Gazette de Trieste" having recently announced that the junction line between the Southern Railway and the Lombardo-Venetian Lines was to pass by Montfalcone; also that the Minister of Commerce had decided for the opening of this junction line, at the very latest, on the 1st January, 1860.

ON THE WESTERN OF FRANCE, the second section—Pont l'Evêque to Honfleur—presents several engineering works of interest, now in course of execution. The Hèbertot Tunnel, 3 kilometres in length; the Calonne and Orange Viaducts; the Cutting at Saint-Mélaine, near Pont l'Evêque, where 332,000 metres cube of earthwork have to be removed; and that of Saint-Martin, 243,000 metres cube.

THE GREAT INDIAN PENINSULA RAILWAY, has 194¾ miles of its line now opened. Gross receipts for the last half-year, £60,889 19s. 2d.; expenses, £26,399 16s. 1d., leaving a net profit of £34,490 3s. 1d., compared with corresponding half of the previous year. Increase in gross receipts, £28,022 7s. 6d.; ditto on net profits, £17,018 17s. 11d.; and decrease in working expenses, 3·49 per cent.

AUSTRALIAN LINES.—THE HOBSON'S BAY Railway Company have completed their arrangements with the St. Kilda and Brighton Company. The Brighton Line is announced for probable completion by the 23rd of August next.

THE SUBURBAN COMPANY'S LINE, first completed portion, as far as Richmond (Australia), has been now opened for traffic for several weeks. The line is to be carried across the Yarra, and through Prahran, until it joins the Line to Brighton.

RAILWAY EARTHWORKS.—A FATAL ACCIDENT has occurred during the construction of the New East Kent Railway from Stroud to St. Mary Cray. On the inquest, held 16th May ult., at Longfield, Kent, it appeared that the deceased, a workman, was killed by a mass of chalk falling on him, whilst standing on a ridge at the bottom of a cutting about 70 ft. deep, from the top of which large masses of chalk were being detached. One mass (of about 9 tons) fell sooner than was anticipated, hurling him into a deep pit at the side, and instantly crushing him to death. Verdict—"Accidentally smothered under a fall of earth."

RAILWAY ACCIDENTS:—

EARTH SLIP ON THE EAST KENT RAILWAY WORKS.—On the night of Sunday, 24th April ult., a fatal accident occurred at the cuttings now in progress for the East Kent Extension Line to Dover, parish of Nomenswold, about 7 miles to the south-east of Canterbury. A slip of earth took place, burying two men, and partially covering with earth a third. One of them was killed.

OFF THE RAILS.—ON THE AIRDRIE RAILWAY, 25th April ult., a train, with eleven loaded trucks, was returning down an incline (near Rawyards), when the engine got too much way, and on reaching Commonhead Station, which is at the foot of one incline, and at the top of another, the engineer was unable to stay the engine, which descended the incline with fearful rapidity, and went off the rails at a crossing, smashing to pieces the engine and trucks. The body of the breaksman was found lying dead under the tender, as also, near it, the dead body of the fireman. The engineer was also severely injured.

ON THE CORNWALL RAILWAY, about 3 miles west of the Royal Albert Bridge, recently opened, a terrific accident occurred, during the night of the 6th May ult., in consequence of the down-train, which left Plymouth at 7·25 p.m., running off the rails, when crossing St. German's (the Notter) viaduct, about 8 miles from Plymouth. The engine and three carriages were precipitated into the river, about 50 ft. below the viaduct, causing the death of the engine-driver, stoker, and one of the guards. Several passengers also were killed. The height from the water where the train went over to the rails is 45 ft.; the water about 7 ft. deep. Engine buried in the mud; the leading 2nd class carriage fell under the water on its back on the engine.

LUGGAGE-TRAIN ACCIDENT—DEFECTIVE AXLE.—On the afternoon of Sunday, 8th May ult., a luggage-train from the North was approaching the Leyland Station, on the Lancashire and Yorkshire Railway, about 4 miles to the south of Preston, when one of the axles of one of the waggons broke down, causing the waggon to be thrown off the line. Before the engine could be stopped, the waggon was dragged several yards, ploughing up the line and displacing several sleepers. Four or five other waggons also left the metals, and were thrown across the down-line of rails. Nearly 8 o'clock in the evening before the line could be cleared.

TROOPS, WAR-STORES, &c., ON RAILWAYS.—The modern use of railways, as a means of transport for troops, ammunition, &c., in time of war, will, in all probability, give rise to an entirely new class of railway disasters; one peculiarity of which we may pretty safely predict, will be the great extent of mischief produced. The first of these casualties we have to record is one that occurred on the night between the 3rd and 4th May ult., when a heavy train, with artillery and bombs, came to a stand still on the rail leading to Verona, and whilst in this predicament, was run into by a succeeding train, conveying the 24th Regiment of [Austrian] Infantry, the result being the destruction of the latter, for the "Vienna Gazette" admits 23 killed and 134 badly wounded. The [military-official] notice of the disaster, published in the Austrian Bulletin, or order of the day, by General Gyulai, is brief, but characteristic. "On the Verona Railway, a train containing military came into collision with some cars containing ammunition; an explosion followed, and several carriages were blown up; 23 men were killed, and 134 (of the 17th Regiment) were wounded. No officers were injured.

COLLISION IN A TUNNEL.—An alarming, but happily, not fatal railway accident occurred (afternoon of 6th May ult.) in the tunnel on the Lancashire and Yorkshire Line, between Bradford and Low-Moor. A passenger train from Bradford for Manchester was followed by an empty train for Low-Moor. On the latter reaching the Low-Moor Tunnel, instead of being signalled to halt at the top until the first train had passed through, the engine-driver was allowed to go on; in consequence the empty train ran into the Manchester one at a spot about 300 yards from the other end of the tunnel, which is a mile in length. Concussion so violent that the buffers of one of the second class carriages were smashed against the engine, and the bodies of the other carriages were all dashed from their frames. Engine-driver of passenger train thrown down; and guard had his head forced through a window. Passengers (about 40) thrown violently against each other, but only one seriously injured. Blame attributed to neglect on part of one (or both) of the signal-men, one of whom is stationed at each end of the tunnel.

COUPLING WAGGONS.—A FATAL RAILWAY ACCIDENT occurred on the evening of the 11th May ult., at the Deepdale Street Station, Preston, of the Fleetwood, Preston, and West Riding Railway. A passenger train had been backed into a siding to have some waggons attached, when, through some mismanagement, the engine was backed improperly. A man employed in coupling the waggons was caught between the buffers of two of the waggons and instantaneously killed.

MARINE STEAM ENGINEERING, SHIPBUILDING, &c.

THE EIGHT SHIPS OF THE (LATE) EUROPEAN AND AMERICAN STEAM NAVIGATION COMPANY have been purchased by Mr. Lever and others, for £250,000; but (as it is said) not for the Galway Company, but as a private speculation. Possibly the French Government were expected to take them.

THE "PHAETON" (late 50 guns) is being lengthened in No. 1 Dry-dock, at Sheerness.

THE FALCON, 17, SCREW STEAM CORVETTE, was, 11th May ult., taken out of Portsmouth Harbour to Spithead, to test her machinery. At the conclusion she was turned over from the Steam Reserve Department to Commander Fitzroy.

A FIRE ON BOARD THE SCREW WHALER "NARWHAL," lying in the Tide Harbour, opposite the gates of King William Dock, Aberdeen, broke out on the night of the 20th April ult. It commenced near the engine-room, and was not suppressed till 4 o'clock on the following morning. Damage estimated at between £1,000 and £1,500.

STEAMERS LOST.—THE "EMPRESS OF INDIA," IRON SCREW STEAMER, an entirely new vessel, on her maiden voyage on a whaling expedition to Greenland, 600 tons measurement, with engines of 100 H.P., with four water-tight compartments (and built at Newcastle last year), went down, 19th March ult., in a heavy sea. Crew (85 in number) saved in boats and on other vessels. Loss of ship attributed (by the captain) to the boisterous state of the weather, the intense frost having contracted the rivets of the iron plates, and in conjunction with blows from the ice, produced a leak. Steamer insured at Lloyd's for £18,000.

THE "REVENGE" SCREW LINE-OF-BATTLE STEAMER, 91 guns, lately launched at Pembroke, has been towed by the *Virago*, 6, paddle-wheel steamer, to Portsmouth, where she is fitting for sea.

IN THE ROYAL DOCKYARDS, between the 1st April, 1848, and the 1st April, 1859, there were built and "converted" 37 line-of-battle ships, 6 blocks, 31 frigates, and 4 mortar frigates. Number of corvettes and sloops so built, 43; of gunboats, 14; besides 1 floating-battery and 2 yachts. Aggregate tonnage of the ships built (including the "converted" ones), and fitted between April, 1848, and April, 1859, 209,408 tons: cost, £4,948,378. The sailing ships converted into screws in dock, measured 54,700 tons: cost, £323,118. Ships repaired, fitted for commission, advanced, and for the steam reserve, &c., measured 914,371 tons: cost, £6,950,766. Gross total amount of these expenses, adding incidental items, £12,614,821; the annual amount varying from £828,734, to £1,562,475.

THE TRIAL TRIPS WITH THE "DORIS" 32 SCREW STEAM-FRIGATE still continue. She got under weigh, 5th May ult., at Spithead, to make a trial of her lengthened screw (from 18 ft. to 20 ft.), at the measured mile in Stokes Bay. The result of six runs at the measured mile, gave a speed in knots of 11·8½ tenths; pitch of screw, 32 ft.; diameter of screw, 20 ft.; draft of water aft, 21 ft. 9 in.; ditto, forward, 19 ft. 6 in.; pressure of steam, 20 lbs.; number of revolutions, maximum, 48·5; mean, 48·25; wind, direction, S; force, 2. At the conclusion of the trial the *Doris* steamed into Portsmouth Harbour and landed her crew on the Shear-Jetty, when she was taken to the Steam Factory to undergo further alterations for the next trial. May 7th, having shipped her altered screw at the Shear Jetty, Portsmouth Dockyard, steamed out to Spithead at high water. Her fourth screw trial took place on the 9th May. The screw used on this occasion was the "common Admiralty Screw," with the leading corner of each blade cut off. Rusult of the trial in a mean of six runs gave over 12 knots, her most successful attempt hitherto. 13th May, got under weigh to make her fourth screw trial (the last with the "Admiralty Screw") but trial deferred on account of weather.

CAST-IRON SLEEPERS FOR BOILERS.—THE "SWINGER" GUN-BOAT, was, 4th May ult., hauled up, on the slip-way, at Haslar, to have her boilers lifted, and replaced on cast-iron sleepers.

THE CUTTING ASUNDER [FOR THE SCREW] OF A 50-GUN FRIGATE.—An operation of some engineering interest took place, 4th May ult., at Portsmouth. The subject of the operation was the *Sutlej*, 50, sailing-frigate (built at Pembroke), which was cut through, something more than one-third her foreward body. The ribands had been previously cut through: and the afterpart of the body of the ship bulk-headed and made water-tight in the inside lower department: two purchases were attached to the bow-timbers; the centre of gravity was calculated to a fraction, and the water was let into the dock. In a few minutes, the fore-part of the vessel was afloat, was hauled ahead, and a gap of some 48 ft. appeared amidships. The whole performance, was skilfully conducted, and reflects credit on the master-shipbuilder. The *Sutlej* is also to be lengthened by the bow, some 12 ft., and by the stern 13 ft.: making her, when complete as a screw-frigate, about 260 ft. in length.

A NEW 91-GUN LINE-OF-BATTLE SCREW-STEAMER, to be called the *Bulwark*, is, by order received 7th May ult., at Chatham dockyard, to be immediately laid down there on No. 6 slip, from which the *Hood*, 91, was recently launched.

A NEW LINE OF STEAMERS, of 500 H.P., to ply between SPAIN AND THE WEST INDIES, is shortly to be established: the Spanish Government has announced, in the 'Madrid Gazette,' that on the 12th August next, it will receive tenders for contracts respecting the new line.

SCREW SHIPS OF THE LINE, NOW (MAY 1859) ACTUALLY BUILDING IN THE ROYAL DOCKYARDS.—*Prince of Wales*, 131 guns, 800 H.P., at Portsmouth, nearly ready for launching; *Victoria*, 121 guns, 1,000 H.P., at Portsmouth, will be ready for launching about June; *Royal Frederick*, 116 guns, at Portsmouth; *Howe*, 121 guns, 1,000 H.P., at Pembroke; *Duncan*, 100 guns, at Portsmouth, will be ready for launching about June; *Gibraltar*, 101 guns, 800 H.P., at Devonport; *Anson*, 90 guns, at Woolwich; *Atlas*, 91 guns, 800 H.P., at Chatham, very forward; *Defiance*, 91 guns, 800 H.P., at Pembroke; *Hood*, 90 guns, 600 H.P., at Chatham, now completed, and is to be launched 4th May; *Irresistible*, 80 guns, 400 H.P., at Chatham, very forward.

SCREW-FRIGATES.—*Aurora*, 51 guns, 400 H.P., at Pembroke; *Immortalite*, 50 guns, 600 H.P., at Pembroke; *Narcissus*, 50 guns, 400 H.P., at Devonport; *Newcastle*, 50 guns, at Deptford, very forward.

EXPERIMENTAL SCREW-FRIGATES.—*Adriadne*, 26 guns, 800 H.P., at Deptford, very forward, and will soon be launched; *Galatea*, 26 guns, 800 H.P., at Woolwich, very forward, and nearly ready for launching.

SCREW-CORVETTES.—*Barossa*, 22 guns, 400 H.P., at Woolwich; *Charybdis*, 21 guns, 400 H.P., at Chatham, just completed, and will be launched 1st June; *Jason*, 21 guns, 400 H.P., at Devonport; *Orestes*, 22 guns, at Sheerness; *Orpheus*, 21 guns, at Chatham.

SCREW-SLOOPS, &c.—*Chamelion*, 17 guns, 200 H.P., at Deptford; *Greyhound*, 17 guns, 200 H.P., at Pembroke; *Mutine*, 17 guns, 200 H.P., at Deptford; *Pantaloon*, 10 guns, 150 H.P., at Devonport; *Pelican*, 17 guns, 200 H.P., at Pembroke; *Ranger*, 5 guns, at Deptford; *Rinaldo*, 16 guns, at Portsmouth.

THE AGGREGATE OF ALL THE VESSELS OF WAR, now in course of construction, at the several ports, is 27—mounting in all 1,547 guns; and of 15,010 H.P.

LAUNCHES OF STEAMERS.—The launch of Her Majesty's line-of-battle screw steam-ship *Hood*, of 91 guns, 3,232 45-94 tons burden, took place at Chatham Dockyard, on the 4th of May ult. She is sister ship to the *Orion*. Her draft of water is 15 ft. forward, and 21 ft. aft. Dimensions:—Length between perpendiculars, 238 ft.; keel, for tonnage, 200 ft. 10⅝ in.; extreme breadth, 55 ft. 9 in.; ditto, for tonnage, 55 ft.; ditto, moulded, 54 ft. 3 in.; depth in hold, 24 ft.

TWO STEAMERS [FOR RUSSIA] have, towards the beginning of the past month, been launched on the Tyne (South Shields). They are not of any great size, and are intended for commercial purposes.

THE "HOWE," 121 guns, 4,000 tons burden, in progress of completion at Pembroke Dockyard, is officially reported as being nearly ready for launching.

FOR LAUNCHING THE "BACCHANTE," 51 screw, sister to the *Shannon*, in June inst., the ways are being laid in Portsmouth Dockyard.

AN IRON-STEAMER FOR THE RUSSIAN GOVERNMENT, was launched 16th May ult., from Mr. J. Laird's shipbuilding yard, at Birkenhead. It is the first of three boats which he is building for river service.

NEW SUPER-HEATED STEAM ARRANGEMENT.—An important experimental improvement in steam machinery has been tried down the river, on board the Peninsular and Oriental Company's ship the *Valetta*. The advantages, more especially to ocean-going steamers, of using super-heated steam, as regards increased power and economy of fuel, have been of late fully admitted—a simple and effective working of the principle, however, has been an engineering difficulty. The new method (that of Mr. Penn) is to place in the smoke-box of the boiler, through which the hot air from the furnace first passes, as large a number of small pipes as is consistant with allowing a free draught from the furnaces. Through all these, the steam from the boilers passes in its way to the cylinders, an average heating surface in the pipes is thus secured; the steam is in a sub-divided form, so as to be readily acted upon, and the waste heat from the furnace is utilised at the point where its intensity is greatest, and where the greatest conveniences exist for applying the apparatus. By means of three ordinary stop-valves, the steam can be shut in or off from the engines at pleasure. The steam is raised in passing along the pipes in the smoke-box (where the heat is about 650°) from a temperature of about 250° to 350°, and so enters the cylinders at 100° in excess of the temperature due to its pressure. A singular fact is noticed, namely, that a smaller amount of cold water is required to condense the steam at this high temperature of 350°, than when at the ordinary heat of common steam.

Steering Fore and Aft.—Her Majesty's paddle-wheel steam vessel *Bain*, constructed on the novel method of steering fore and aft, with equal facility, recently commissioned at Woolwich for coast surveying, sailed, 17th May ult., from Woolwich for Greenhithe, to be adjusted for sea.

Marine Stokers.—Many of the men who had arrived in Portsmouth from the outports, where they had been entered for the navy as "stokers," having proved, on being tested, to be totally unacquainted with a sea-going stoker's duties, the *Lucifer* steamer was, 18th May ult., ordered to get up her steam to take a party of men on board and proceed with them outside, to test their qualifications.

A New Steam Ferry is projected to carry horses, carts, &c., across the river Thames, from New Crane Wharf, Shadwell, to Hanover Stairs, Rotherhithe.

For the Navigation of the Bosphorus, a new screw-corvette, a gunboat, a dispatch-boat, and four other vessels, are being built by Messrs. White, at Cowes.

Steamer Launches.—The next launch at Pembroke Dockyard will be that of the *Greyhound* screw steam-sloop (pierced for 16 broadside and 1 pivot gun), which is to take place on the 1st of June.

The Steamer "Volunteer," of Newcastle (a fine vessel of about 300 tons burthen), foundered, on the 19th March ult., in the ice in the Arctic Seas, about 5 p.m. She was steering a course (for Greenland) of N.N.W., and going at the rate of about three miles an hour, when she struck a mass of ice with such force as to cause her to spring a severe leak. She shortly afterwards foundered. Crew picked up by the *Arctic*, Peterhead.

Screw Steamers now Building at Woolwich — *Galatea, Anson, Barossa*, and *Repulse*.

The "Majestic," 80 guns, Screw Steam-ship, in the fitting-basin at Sheerness, is progressing rapidly with her fitment of rigging, &c.

A Steamer Struck by a Whale.—The *Urgent* screw steam troop-ship (which left Gibraltar on her return to England on the 14th May ult.) when (on the 16th) in lat. 39·46 n., long. 9·40 w., was struck by a whale on the starboard-bow; the shock was so great that the people rushed on deck, fancying that the ship was ashore, or that a serious collision had occurred with some other vessel.

The "Trafalgar," 91 guns, 500 H.P. (nominal) screw steam-ship, underwent (20th May ult.) in the Fitting Basin at Sheerness, what is termed the "contractors' trial" of her engines (set up by Messrs. Maudslay, Field and Co). Trial satisfactory. Vacuum 26. Ordered to the Western Yard for immediate equipment.

Rapid Ship-building.—The "Anson" 91, Steamship, commenced but three months ago, under the shed from which the *Edgar* was launched, at Woolwich, is advancing with rapidity. The first piece of her keel was laid on the blocks to commence her construction, no longer back than the 15th February of the present year; and, during that period, two-thirds of the ship have been thoroughly completed, the remaining portion being the interior fittings alone. This is an instance of expedition in building a line-of-battle ship of similar dimensions hitherto, we believe, unprecedented.

The "Neptune," 91, Screw Steam-ship, being fitted out in the steam-basin at Portsmouth yard, got up steam, 12th May ult., to try her machinery. Trial perfectly satisfactory. Her engines are of 500 H.P. (nominal), by Messrs. Ravenshill, Salkeld, and Co.

The Channel [Steam] Fleet, now consists of 15 sail of screw line-of-battle ships, supported by a corresponding number of steam-frigates, corvettes, and gun-boats. The following are the line-of-battle ships commissioned, and nearly ready for the pendant.

Royal Sovereign	131	Royal Albert	121
Royal George	102	Agamemnon	91
Algiers	91	Cæsar	91
Colossus	81	Cressy	81
Edgar	91	Hero	91
Exmouth	91	Neptune	91
London	91	Trafalgar	91
Queen	91		

The above ships are the noblest of their class.

The "Emeu," Australian Mail-Steamer, on her last voyage, broke her main shaft, when about 1,000 miles from King George's Sound, having to proceed to Mauritius under canvas, and thence to Bombay, with one engine, there to get a new shaft. Her mails and passengers transferred (at Mauritius) to the company's ship *Grenada*, which brought them up to Suez.

The "Amphion" New 36 Steam-Frigate, now building in Chatham dockyard, is being finished with all possible despatch. She is very nearly ready for undocking.

The Machinery and Boilers for the screw steamship *Sanspariel*, 70, arrived at Plymouth, 14th May ult., by the paddle-wheel steam store-vessel *Rhadamanthus*, 4, from Woolwich.

Iron Steam-frigates, or "Rams."—It is now decided that the Thames Iron Company is to build the first of the huge iron-coated steam-frigates, or rams, for the royal navy. The design selected by the Lords of the Admiralty was prepared by the surveyor of the navy at the beginning of the present year. No less than 15 designs were submitted to the Admiralty by Messrs. Laird, Mare, Napier, Palmer, Scott Russell, Samuda, Thames Iron Company, Westwood, and Baillie, and the master shipwrights of Her Majesty's dockyards. The chief conditions stipulated for, were, that the ship should carry 36 guns, should travel at 14 knots per hour; and should be covered over with a certain portion of its length, with $4\frac{1}{2}$ in. iron, backed by 2 ft. of solid timber. All other elements, such as dimensions, H.P., &c., were left entirely to the discretion of the designers. The extremes between which certain measurements of the several designs ranged, were, as regards length, for example, the least, 340 ft.; of the greatest, 430 ft.; whilst the breadths proposed varied between 52 ft. and 60 ft.: draught of water between 21 ft. 9 in., and 26 ft. 6 in.; H.P., between 1,000 and 1,800; tons burthen, between 4,887 and 7,554. The proportions of the weight of hull, per ton (exclusive of armour-plate) to the burthen in tons, ranged between 48 and 86 per cent. In the (Admiralty) design, to be adopted (prepared, as it appears, before the others were sent in), a mean of all these designs is taken:—namely, the length is to be 380 ft.; breadth, 58 ft.; H.P., 1,250.

H. M. Steam Store-ship "Supply," last at Gibraltar, experienced such severe damage, through stress of weather in the Mediterranean (whilst conveying boys and provisions for the navy to be landed at Gibraltar and Malta, and to proceed thence to Asia Minor), that the consequent repairs will amount to, at least, £2,000.

The "Hannibal", 91 Guns Steamship, was, 19th May ult., swung at Spithead, for adjustment of her compasses.

MILITARY ENGINEERING, &c.

The French Emperor's New Cannon (Siege-guns and Field-pieces), are thus described in the French Journals:—They are, internally, grooved, as in the rifles or carbines *de précision*. The calibres are of two dimensions only—viz., 11-pounders for siege guns, and 4-pounders for field batteries. For the navy, the calibres remain unaltered. The solid ball is done away with, the projectile being one which strikes like a full shot, and then bursts like a shell; thus having a double effect. It is fitted with waddings of lead, which enter into the grooves of the gun and give the requisite precision to the aim. This new piece is equivalent to one of 24 of the old system, the size ordinarily used for opening a breach. Against a massive butt of masonry a battery of ancient 24-pounders was pointed at a distance of 35 metres—viz., that at which fire is generally opened against a rampart. A second mass of masonry, similar to the first, was breached by a battery of 12-pounder new guns, but at a distance of 70 metres. The experiments proved that fewer rounds from the rifled gun were required to open the breach than from the old 24's, and at *double the distance*. The 4-pounder field-piece is so small, that it may be termed the "artillery rifle," weighing less than 300 kilogrammes. Six gunners can carry it on their shoulders without difficulty. The charge of powder is only 500 grammes, and it sends the ball 4 kilometres (about $2\frac{1}{2}$ miles).

Improvements in Grapeshot.—The *Serpent*, target-vessel to the *Excellent*, gunnery ship in Portsmouth Harbour, had (11th May ult.) a quantity of 4-in. oak-plank bolted on her side for the purpose of testing a new system in the making up of grapeshot. The *Undaunted* is also preparing, in the Ship Basin, to have a huge target fixed to her side to be likewise experimentalised upon by the *Excellent*.

The Nothe Fortifications for the protection of the town and harbour of Weymouth, and also the adjacent roadstead of Portland, are to be proceeded with immediately.

At Malta the Military Works are being inspected by a commission composed of a colonel of artillery and a colonel of engineers, lately arrived there from England, the object is, to add considerably to the strength of the defences by increasing the number of guns, and by substituting for old guns, ordnance of more modern construction.

Shot and Shell.—The Woolwich Arsenal Foundry, for the special department of war manufacture, is, at present, turning out at the rate of 26,000 rounds (of shot and shell) per week. Working overtime, and during the night, this weekly total can be raised to nearly 40,000 rounds. The Official Returns made to the Board of Ordnance, show that the (shot and shell) consumption during the siege of Sebastopol was as follows:—In the first bombardment, commencing October 17, 1854, there were 72 siege-guns employed, which fired, in all, 21,881 rounds; in the bombardment commencing April 9, 1855, there were 123 guns and 30,633 rounds; in that commencing on the 6th June, 155 guns and mortars fired 32,883 rounds; in that commencing on the 17th June, 166 guns used 22,684 rounds. The attack of August 17, was by 196 guns, and 26,270 rounds were fired; and on the final bombardment of September 8th, 207 guns and mortars consumed 28,476 rounds of shot and shell. These numbers, with 88,640 rounds, fired casually, or to repel night attacks, and 405 rounds of carcasses and "light" balls give a total of 251,872 rounds of shot and shell fired by the English during the whole siege from first to last.

Siege—Firing from Ships.—In the combined attack by the fleets on the sea forts during the land bombardment of the 17th October, 1854, the *Agamemnon*, in the course of four hours or so, fired away upwards of 3,000 rounds of shot and shell; and the *Rodney, Sanspareil*, and *Bellerophon* expended nearly the same enormous quantity.

The late Lancaster Gun Factory Machinery at Woolwich Arsenal (now merged in the new Armstrong establishment), consisted of thirteen large furnaces, and nine steam hammers.

The Minie Rifle Bullet Machines at Woolwich Arsenal, are turning out the conical balls at the rate of 2,000,000 rounds per week—a number which can always be increased to 3,000,000, by keeping the machines going during the night as well as day.

The New Pattern [French] "Rifled Field Gun," recently substituted in place of the "Napoleon Gun" in the batteries of the Army of Italy, is a grooved brass-piece, of the calibre of a 4-pounder, loading at the muzzle. The shot is a cylindro-conical projectile, of cast iron, with zinc *ailettes* or feathers to take into the grooves, and give the necessary rotary motion. The actual weight of the shot (although the calibre of the gun is that of a 4-pounder), not being spherical, is considerably more than 4 lb.—probably 6 or even 8 lbs. The range is greater than that of any field-piece (hitherto) in the French service: requires only four horses for its draught; which is a saving of two horses per gun. Requires less gunners; throws shells and canister.

The French Infantry are armed with rifle-muskets; the Chasseurs de Vincennes with "carabines à tige."

Military Bridge-building.—When the Austrian corps (the eighth under General von Benedek) crossed the river Po at Cornale, a few days ago, although the night was as dark as pitch, the [temporary] bridge, which was 730 ft. long, was completed in 58 minutes.

The "Napoleon Gun"—(now superseded by the new (French) rifled field-gun)—was introduced about ten years since by the Emperor into field-batteries. It is a brass 12-pounder, to throw shot and shell, weighing about 13 cwt.; and, in fact, equivalent to a 9-pounder bored up to this larger calibre. The horse-artillery and field-batteries were all armed with the same guns; and howitzers were done away with. Subsequent (practical) experience, however, demonstrated the disadvantages attendant on this uniformity of calibre, more especially as regards range, accuracy, and effect. Hence the recent substitution of the new gun.

For Defence of the Arsenal at Pembroke, and the protection of Milford Haven, engineering-surveys have been making for some time past, and new works (fortifications) are to be immediately commenced. Two commanding points have been selected; and solid works are to be erected upon Popton Point, and upon ground contiguous to Conjuick. The Great Head, commanding the entrance to the Haven, is also to be fortified.

"Incendiary Shells" ["Liquid-fire."]—Captain Norton, in a letter to the public press, dated 23rd April ult., announces that he does not "pretend to any claim on the liquid-fire concoction, bisulphuret of carbon and phosphorus," which he (Capt. Norton) considers to be the most "naufragious" fire-stuff ever invented by the ingenuity of man; and that his improvements are confined to the appliances, by means of which any specific chemical substances may be safely and effectually used in incendiary shells, &c. for warfare.

The Management of Rifled Ordnance is henceforth to form the subject of special arrangements (specified in the new system of Royal Artillery instruction), and will, in the first instance, be carried on under the immediate superintendence of the Staff of the School of Gunnery, and be gradually disseminated throughout the corps. "The officers of each corps are (by the late general order) reminded how inseparable artillery practice is from the deductions of theory; and how a knowledge of the general rules of Mechanical Science will facilitate all operations, whether as regards the acquirement of good gunnery, or the management of heavy ordnance and military machines."

At Portland, the works of the New Fortress and Batteries are assuming a formidable appearance. The main portion of the breakwater is fast approaching completion, and already affords secure and most welcome anchorage to the mercantile marine during the prevalence of contrary winds; and is frequently the resort of men-of-war.

The Armstrong Gun Factory, in Woolwich Arsenal, is now in full progress of erection. The foundation was completed on the 5th May ult., and the foundation for the building commenced. Contrary to expectation, no formality, such as that of Sir William himself laying the foundation-stone, &c., took place on the occasion. The building is to be double storied; the principal entrance being ornamented with Gothic turrets. The architectural design was furnished by the Commanding Royal Engineer.

Iron and Cotton Targets.—The recent experiments at Portsmouth from the screw gun-boat *Stork*, tender to the gunnery-ship, have resulted in the fact that the iron target, filled with combustible cotton is next to worthless. The old *Undaunted* (42) sailing-frigate, was moored up the Porchester Lake, having such an iron target affixed amidships, below her main-deck ports. The *Stork* was placed about 400 yards distant, and in the course of half-a-dozen rounds the target was riddled, and knocked to pieces.

The Bayonet—Origin and Use.—The emphatic mention of this arm by the Emperor Napoleon III., in his recent proclamation to the army of Italy, has induced the "Moniteur de l'Armée" to remind its readers that the bayonet (*baïonette*) is of French origin, and takes its name from the town in which it was first invented, *i.e.*, Bayonne. It was in 1641, that an engagement took place between some Biscayan peasants and a band of smugglers, that this species of weapon, which subsequently made an entire change in the system of European warfare, first made its appearance. After having exhausted all thei ammunition, the Biscayans hit upon the expedient of fixing their knives to the end of their muskets, and thus were enabled to disperse their antagonists. The bayonet was used for the first time, in regular warfare, in France, in the regiment of the Royal Fusileers (Fusiliers du Roi), in 1670. In 1674 and 1675, some other infantry regiments were supplied with it. The dragoons had it in 1676; the grenadiers, in 1678. At this period, the bayonet was thrust inside the barrel: the socket ("douille"), which so greatly simplifies and facilitates its use, was invented and adopted in 1688. The first French "charge" with the bayonet was at the Battle of Spire; but it had been in (partial) use some nine years previously, namely, at the Battle of Turin.

HYDRAULIC ENGINEERING.

"The Question of Water-winding" or "Hand-winding" for the New Westminster Tower Clock appears to be an additional and still vexed question between the authorities entrusted with the practical details of this very dilatory affair of the "Great Bell and Clock"—already surrounded with so many (apparently) perplexing difficulties. Mr. Dent, in a recent communication to the Press on this subject, remarks—"Whether it" (the Great Clock) "is to be wound by hand or water-power, is chiefly a question of expense. Hand-winding is certainly the safest, and I believe it will turn out to be the cheapest * * * but, if it is thought fit hereafter to add the water-winding apparatus, it could be done at any time, without interfering with the hand-winding—having been designed with that view," &c.

The Water-pipes of the Vehar [India] Waterworks are, according to the "Bombay Standard," bursting at a pressure of 70 or 80 ft. of water. They were purchased to bear a pressure of 400 ft., and cost upwards of £300,000. They were ordered by the East India Company, not by the Contractors for the Waterworks.

GAS ENGINEERING—(HOME AND FOREIGN).

The Parisian Gas Company's Report for 1858 gives the following items:—Gas, coke, and tar, produced by them in 1858, to the value of 16,832,072 fr. (£673,328 18s. 4d.) Total receipts, 17,586,781 fr. (£703,471 5s.); total expenses, 11,473,319 fr.—leaving a profit of 6,113,461 fr. (£244,538 9s. 8d.)

The Imperial Continental Gas Association, at their last half-yearly meeting (25th May ult.), declared a dividend.

Gas Lighted by Electricity.—Two "sunlights," each containing seventy-five burners, have just been placed immediately under the ceiling in the centre of the Music Hall, in the Edinburgh University; the ceiling, being 43 ft. in width and 50 ft. from the floor. These burners have been successfully lighted by an application of the electric current. The galvanic-battery is placed in the cellar, and from it positive and negative wires are carried up the sides of the Hall and along the ceiling to immediately over the burners, the wire is curled round the poles of an electro-magnet, to the keeper of which are attached a couple of wires bearing a platina wire. On the current being established at the battery, the platina wire, placed within an inch of the burner, becomes red-hot; and the gas being simultaneously turned on, the whole seventy-five lights, which are closely contiguous, immediately flash into flame. The current is there interrupted at the battery below, and the electro-magnet, ceasing to be a magnet, its keeper, with the wires attached, falls 3 in. below the flame, so drawing down the platina wire which, were it to remain in position, would be destroyed by constant exposure to the powerful flame of the gas.

HARBOURS, DOCKS, CANALS, &c.

At Pembroke Dockyard, it is stated to be the intention of the authorities to strengthen the approaches, by the erection of a powerful battery of heavy guns on the Great Head, facing the mouth of the harbour.

Dover Harbour [of Refuge].—The great pier, commenced in October, 1847, has now stretched itself far into the deep water of the channel. Lines of railway from the dockyards at Chatham and Portsmouth, and the camps of Aldershott and Shorncliffe, are already in existence, close up to the pier: and it is proposed to continue these lines down the pier to the jetties, by which means the landing and embarking of troops, horses, baggage, or naval stores, will be effected with ease. The depth of water allows troop-ships of great depth of water to come alongside at all times of tide. The outer landing-jetties (nearly completed) have 42 ft. depth of water at low-water of spring-tides, sufficient for the largest ships of the line at the lowest tides. The length of pier finished at this date, is 1,250 ft.; the superstructure is completed of 1,050 ft.; the width of the pier, at the base, is 84 ft.; at the quay-level, 45 ft.; the area enclosed will be 320 acres, with upwards of four fathoms in depth at low-water. Contractors, Messrs. Lee; resident engineer, Mr. Edward Druce. The parliamentary grant has never as yet exceeded £34,000 per annum, and this amount has regulated the progress of the work hitherto. The present aspect of affairs may possibly tend to hasten the completion of the works.

In the Kustendjie Harbour (Black Sea), 200 yards of the pier have been constructed. Supply of native labour abundant.

At Keyham [Steam] Dockyard, Devonport, considerable additions are making, especially with a view to its military connection with the Cornwall and South Devon Railway.

The Nicaragua [Inter-oceanic] Canal is at last in progress. From Nicaragua, it is reported, that M. Belly, has been successful with the Government, and that on the 29th March ult., the corner-stone of this canal was laid at San Carlos, in the presence of Presidents Martinez and Mora.

The Thames Graving Dock Company are in full operation. The undertaking was formed in 1857, and Mr. E. Clark's patent machinery and arrangements are stated to have fully realised the expectations entertained. From the Directors' (recent) report it appears that, up to the end of April last, eight ships, varying in burthen from 500 to 1,800 tons, of wood and iron, sailing ships, paddle wheel and screw steamers, have been raised, floated, examined, and repaired with a degree of ease and celerity unknown under the old system of graving docks. The pontoon, recently launched, has been employed in raising and floating several ships. One vessel was raised, examined by Lloyd's surveyor, and again launched in one hour and a quarter. The action of the lift has been found to be perfect; and, in no case, has a vessel been subjected to unequal strain.

Canals, Ports, &c. [in Spain].—On account of the increasing development of public works in Spain, an augmentation in the staff of the corps of Civil Engineers is to take place. The "Gazette" publishes that the Engineers of Roads, Canals and Ports, are to be composed of 5 inspectors-general, 15 district-inspectors, 30 first-class engineers-in-chief, 50 second-class ditto, 80 first-class engineers, 120 second-class ditto, 15 candidates of the first class, and 25 of the second.

The Alterations at the Southampton Docks which have been in progress for several months past for deepening the inner docks, are now complete, at an estimated cost of £50,000. The dock now occupies an area of 10 acres, and the depth of water is 30 ft. It is capable of giving quay-berths to 16 of the largest steam-ships afloat. Cranes are fitted all around, and a tramway traverses both the inner and tidal docks, having communication with nearly all parts of England without break of gauge. There is no rise and fall of the water in this dock, and it can always be lowered at pleasure, so that any vessel embarking or landing cattle can be placed on a level gangway; thus allowing the animals to walk on board or otherwise—a feature of great practical advantage.

The Suez Canal (according, at least, to French advices from Alexandria to the 11th May, ult.) is progressing without further impediment. The English Consul had announced that he had received no instructions hostile to the enterprise. The Austrian Consul had endeavoured to interpose some difficulties; but Saïd Pacha had taken no notice whatever of his objections.

Enlargement of Pembroke Dockyard.—It is in contemplation to purchase part of the foreshore and the ground to the east of the dockyard, and to extend the establishment in that direction, forming a steam-basin off West Llanion Pill.

BRIDGES, VIADUCTS, &c.

Testing Bridges.—The test of the Government inspector, recently applied to the Saltash tubular bridge, was a load of 400 tons; under which the bridge deflected one and a quarter inch. Each span, before lifting, had been tested with a strain equal to $5\frac{1}{2}$ tons per in. on the tubes and chains; and deflecting the entire span 7 in.;—a deflection which recovered itself immediately after the mass was removed.

Suspension Bridges [with Girders].—The question whether the resistance to strain of the suspension part (in these constructions), and the girder part is simultaneous?—a very interesting point—still remains unsettled amongst practical bridge-architects and builders. In the Chelsea-bridge the girder is employed, but only for an ordinary roadway; and, probably, with no view to primary support: otherwise, we would gladly learn the architect's ideas and expectations on this head. Where the structure is intended to carry a railway, the question to which we have alluded, becomes of paramount interest.

Hungerford Suspension Bridge has a centre-span of 632 ft. 4 in.

River Saone [France.]—The suspension-bridge over the Saone not being sufficiently high, especially when the river is swollen, it has been lately resolved to raise them. That of Trans was first commenced: on its completion, heavy weight was put on one side, to test its solidity; but the cables broke, and half the bridge, together with the weight, fell into the water. Two men, father and son, were on the bridge at the time; the latter was precipitated into the river, but the former plunged in and rescued him.

The Opening of the "Royal Albert," or "Great" Tubular Bridge over the Tamar, at Saltash, for the Cornwall Railway, took place on the 2nd May ult. The ceremony was enlivened by the presence of the Prince Consort in person, and by that of the municipal authorities of Plymouth, Saltash, and Devonport in civic costume; but the absence, through continued illness, from the scene of engineering triumph, namely, of the designer of the great work (Mr. Brunel), was felt to cast a gloom over the otherwise exciting festivities. At 12·20 the guns from the flagship and citadel announced the arrival of the Prince at the junction of the Cornwall Line, about 2 miles from Saltash. Complimentary addresses having been presented, and suitably replied to, the Royal train moved forward and entered the Albert Bridge at a slow pace. A slight vibration was perceptible, but much less than was observed when a company of soldiers, tramping in regular step, crossed it a few minutes before to the Saltash side. The train continued its course through the Saltash station, and passed on to the Coombe Lake viaduct. Thus was worthily inaugurated one of the noblest engineering works of modern times, destined, henceforth, to unite the important counties of Devon and Cornwall.

Dimensions, &c. of Saltash Bridge.—Spans, or arches, in the whole structure, nineteen; the smaller of these lead from the hills at either side to the edge of the Tamar, and consist of massive double columns of solid masonry, 11 ft. square, with wrought-iron longitudinal beams of boiler-plate, to carry the roadway on either side. The main stone piers are at the water's edge, and support the ends of the great spans crossing the river. Each pier is of granite, 20 ft. wide by 17 ft. thick, and 190 ft. from foundation to summit. The main pier, in the centre of the river, on which both of the spans rest, and on which all the pressure and vibration has to be supported, is one of the most surprising efforts of engineering skill. The details of its construction, although of the highest interest, are too intricate for a condensed notice. On this massive (granite) pile the iron columns for the centre pier are raised. There are four octagon columns, 10 ft. in diameter and 100 ft. high. Each stands 10 ft. apart from the other, in the centre of the granite, forming a square of about 30 ft., and all bound together with a handsome massive lattice-work of wrought iron, which checks vibration and prevents any lateral thrust. The weight of each column is 150 tons, each being cast in 6 ft. joints, 2 in. thick, and supported inside with powerful ribs and angle irons. The total quantity of wrought iron used has been 2,700 tons; of cast iron, 1,300 tons; of masonry and brickwork, 17,000 cubic yards; and about 14,000 cubic ft. of timber. The pressure on the centre pier foundation, when the whole bridge takes its bearing, will be more than 8 tons to the foot, or double the pressure of the whole mass of the Victoria Tower on its basement story. Lateral motion is counteracted by the transverse floor-girders under the roadway; and the ballast checks vibration. 6 in. have been allowed for contraction and expansion; but the greatest difference yet observed between the coldest and the hottest day has only been 3 in. in the entire length of both spans. The greatest strain which the bridge can now undergo, covered with earth to the depth of a foot, and loaded with a train of locomotives, will be less by half a ton per inch than that to which the spans before being lifted were subjected; that is to say, to a strain, including their own weight, of 2,300 tons, to a strain of about $5\frac{1}{2}$ tons per inch of section on the tubes and chains.

The Saltash, or Royal Albert Tubular Bridge, recently opened, consists of nineteen spans, or arches, seventeen of these are wider than the widest arches of Westminster Bridge; while, two, resting on a single cast-iron pier of four columns, cross the whole stream of the Tamar, at one gigantic leap of upwards of 900 ft., or a greater distance than the breadth of the Thames at Westminster. Total length of the structure, from end to end, 2,240 ft., or very nearly half-a-mile; and 300 ft. longer than the entire stretch of the Britannia Bridge. Greatest width (being for a single pair of rails), 30 ft. at basement; height, from foundation to summit, 260 ft., or more than 50 ft. higher than the monument?

The Buffalora Bridge over the Ticino [Sardinia] is again, it would appear, in jeopardy, as the (renewed) report of its having been blown up by the Austrians, as the first result of their hostile movement towards Sardinia. is again in circulation. This bridge was constructed at the joint expense of Austria and Sardinia, on the road to Milan and Novara. Half of it was to serve for the railway-junction between the Lombardo-Venetian and Sardinian Lines—the other half was to be left open for carriages and foot-passengers; and the Piedmontese Senate had just unanimously adopted the project of law, abolishing the tolls on this bridge.

The Victoria Bridge, Montreal.—The centre, and longest tube (330 ft.), was successfully fixed on the 26th of March last. The scaffolding was built on the ice; but the next day the ice began to "shove," carrying with it a portion of the scaffolding. The tube is now firmly fixed. If the ice had moved before the ends of the tube were resting on the piers, the whole must have fallen into the river. Mr. Hodges, engineer, and agent of Messrs. Peto and Co., the contractors for the bridge, superintended the entire arrangements connected with the fixing of the tube.

The Bridge over the Scrivia [close to Tortona] has been all but entirely destroyed. Official advices from Turin, announcing that, on the evening of the 6th May ult., the Austrians had burned seven of the arches. Subsequent advices state that the Sardinian engineers have (on retreat of the Austrians) reconstructed this bridge.

The Coombe Lake Viaduct, on the Cornwall and Devon Railway, although constructed of wood, is, in an engineering point of view, almost as interesting in its way, as its fellow viaduct, the colossal iron-span of Saltash. Its height from the water is about 120 ft., and so slight looks the web of neatly arranged beams, which, rising one upon another, carry the roadway high over all, that it taxes the passengers' confidence in Mr. Brunel to the very utmost to venture on it in a heavy train. It has, of course, been properly tested, and before proof, was known to be strong enough for its purpose.

The St. Austel Viaduct, higher up on the same line, is likewise a wooden structure, spanning a tremendous ravine, at a height of 156 ft. from the ground.

The Kehl Bridge over the Rhine is in active progress. The foundation works of the first pier, near the French side of the river, are advancing rapidly. The four caissons forming the foundations for this pier, and which serve as a workshop for the men, are, at present, sunk to the depth of 15 metres below the bed of the stream. As regards the opposite piers, on the Baden side, the "Courier du Bas-Rhin" announces that the four caissons are to form one single block, and are to be sunk in one piece. That the upper part of them is to be laden with "béton," in proportion as they sink below the bed of the

Rhine: when they shall have reached the required depth, the caissons themselves will be filled up with béton, which will be run into them through the tubes which at present serve as dredging-vents. When the caissons are filled with béton, these vents, or chimneys, are to be removed, and the mason-work of the piers is to be built up, resting upon the bétonised caissons. The blocks of béton, serving as the basement for the masonry piers, are themselves of the weight of 12 millions of kilogrammes. As for the intermediate piers between the French and Baden shores, their erection, it is anticipated, will occupy much less time than the foregoing, as the foundation-works will be carried on by means of a single caisson.

Near the Boulevard Mazas, the six piers for the Pont biais (Skew Bridge), three on each side of the road, to carry the Vincennes Railway over the Boulevard, are in progress of construction.

The Railway Bridge at Valenza has been destroyed by the Austrian troops.

BOILER EXPLOSIONS.

At Old Mill Lane, Huddersfield (Messrs. Learoyd and Co.), 28th April ult., one person killed, and six injured. The boiler had been examined by the inspector of the Huddersfield Boiler Association only on the preceding Wednesday evening, and the water-gauge and safety-valve had been pronounced in proper working order. Boiler, tubular, 7 ft. 2 in. diameter; had two circular flues of 2 ft. 6 in.; thickness of plate, 5-16th of an inch; feeder, self-acting; for (as calculated) always keeping a fixed quantity of water in it. The engine tender, after greasing the engine and looking at the gauge, left, at dinner hour, the engine in charge of the assistant fireman; in about twenty-five minutes afterwards the boiler exploded, knocking down a one-story building adjoining, in which several persons were engaged at work, and who were buried in the ruins, but extricated with the above result.

The Boiler of the Steamboat "St. Nicholas," exploded on the Mississippi on the 24th April ult., 75 persons (as reported) killed, and many wounded.

MINES, METALLURGY, &c.

The Lake Bathurst Australasian Gold Mining Company's affairs are being wound up before Vice-Chancellor Sir W. P. Wood. List of contributories in class B. to be settled on the 31st May.

An Important Gold Discovery has recently created much excitement in Bendigo. According to the Melbourne "Argus," a conglomerate metal, very common in that gold field, but which has, hitherto, been regarded as useless, has been found to yield as much as 150 ounces of pure gold to the ton, with a very large per centage of zinc. The analysis gives—zinc, about 45 per cent.; iron, about 20 per cent.; sulphur, about 15 per cent.; arsenic, about 11 per cent.; other extraneous substances, about 9 per cent.; gold, about 1 per cent.: total 100—giving a result of 1 ounce of pure gold out of every 100 ounces of the conglomerate. This sample was taken from the North Whip Reef.

A New Coal-vein in Spain has been discovered in the district of Yrun, on the Spanish and French frontier, and in the immediate proximity of the Northern Spanish Railway. A company has already commenced working these mines, which are described as furnishing excellent coal, equal indeed to English coal in quality.

Australian Copper.—Late advices from Adelaide bring intelligence of great discoveries of copper deposits in the northern districts of South Australia. Samples of native copper, malachite, and copper-ore, of extraordinary richness, have been received at Adelaide from the newly opened mines of the Chambers, North Rhine, and Appealina.

At the West Silkstone Colliery, near Barnsley, a fire broke out about midnight (7th May ult.), in the engine-house. The watchman, who appears to have fallen asleep in the engine-house, was so severely burned, that he died a few hours afterwards. Damage done to the works not considerable, so that in two or three days the pit would be again in working order.

Aluminium-bronze.—A new metallic alloy, discovered by M. Henri Sainte Claire Deville, is under investigation in the Paris Academy of Sciences. The qualities of the new alloy are stated to promise great results in their application both to machinery and the manufacture of fire-arms. As respects hardness and toughness, its first successful practical test has been in the construction of "coussinets" (rubbers)—"glissières (slides), and friction-surfaces in machines. 1°. A "coussinet" was attached to a polishing-lathe, making 2,200 revolutions per minute: it lasted nearly eighteen months, in constant work, nor was it till after that period that it showed symptoms of wear. Other "coussinets" under the same conditions, do not last more than three months. 2°. A "slide" for a sawing-machine, working at 240 revolutions per minute, lasted upwards of a year, in constant use; and at the end of that time, showed not the slightest trace of wear: the bronze "slides" in ordinary use last no longer than four months.

A Large Casting (for an anvil-block), intended for an immense hammer to be used in the making of the Armstrong guns, was cast at the foundry of Messrs. Morrison and Co., Ouseburn, Newcastle-on-Tyne. When finished, it will weigh 21½ tons. It was cast in one run; the quantity of metal melted for it being 23 tons. Size of the base 6 ft. 6 in. by 9 ft.; thickness 9¾ in.: it will have to lie a week, before it will be cool enough to be raised.

A Fatal Smelting-furnace Explosion (two men killed) occurred on Sunday morning, 8th May ult., at Corbyn's Hall Blast Furnaces, near Kingswinford. Cause, the sudden decomposition of water, and consequent production of that most explosive of all vapours, oxy-hydrogen gas. The men were preparing to "tap" a furnace—that is, to make an opening at the bottom of the furnace to allow the melted pig-iron to run into moulds prepared to receive it—when, suddenly, an immense mass of molten iron and fire were forced out upon them. Two of the men were burnt nearly to the bone, their skin hanging down in large strips: four others frightfully injured. The flames extended right across the casting-shop, setting a beam on fire; and the walls were covered with small pellets of iron, forced against them by the violence of the explosion: the cause of which was the leakage of what is termed a "tuyere"—a parabolically or conically-shaped double-sided piece of iron (fitted on to the blast-pipe where it enters the furnace)—between the outer and inner-side of which, water, by mechanical means, is made continually to flow, thus keeping the end of the blast-pipe which enters the furnace at a comparatively low temperature, to prevent its melting.

The Copper-mining Prospects of South Australia, according to the local correspondence, continue to improve rapidly; so much so, indeed, as to warrant some degree of caution in crediting, to the full extent, the very flattering accounts that have reached Europe, more especially as regards the newly-worked mines in the north of the colony. One of these mines, the Appealina, for instance, at a depth of only 3 fathoms, had proved so productive of rich copper, that the shares were at 600 per cent. premium (advices from Adelaide to the 18th March ult.). The Burra Burra had declared its thirty-seventh dividend of 100 per cent. The Kapunda was increasing both in quality and quantity. The North Rhine had proved to be productive of the richest ores, although the deepest shaft is down only 14 fathoms. Chambers' Mine is described as containing immense quantities of malachite and copper.

Exports from England, in the month of March, for the last three years (as extracted from the recent Trade and Navigation Returns:—

	1857.	1858.	1859.
Metals—Pig iron	£135,523	£74,777	£94,053
Bar iron	287,274	163,716	243,152
Wire iron	10,545	14,883	17,786
Railway iron	349,492	196,118	419,961
Cast iron	72,612	61,047	98,487
Wrought iron	314,345	208,322	281,676
Steel (unwrought)	68,747	39,576	72,663
Copper (unwrought)	42,575	36,009	50,959
Ditto (sheets and nails)	135,522	124,773	116,722
Lead	53,127	22,141	48,086
Tin (unwrought)	16,690	21,455	20,121
Tin-plates	132,456	96,960	169,464

Iron and Steel [Amalgamation].—The Belgian Journals state that means have been discovered of perfectly uniting steel and iron; and that, at the Iron Works of Montigny-sur-Sambre, rails have been made of which the flange is in steel and the body in iron; thereby insuring a much greater degree of durability in the new description of rail than is produced by the ordinary mode of manufacture.

New "Leads" or "Runs" of Gold have just been discovered and opened up at Black Dog Creek, near the Indigo, in the Ovens district, and generally called New Ballarat; another at the Back Creek, near Amherst, in the Maryborough district; and thirdly, at Commissioners' Hill, close to Avarat. The deposits are described as being rich and extensive; but there is a declared want amongst the miners in the Quartz Reef Districts for machinery to crush the surface crop, &c. There is (near the Black Dog Creek, for instance), but one crushing-mill in operation, although the quartz passed through it has yielded an average of 5 oz. to the ton.

APPLIED CHEMISTRY.

The Silicifying of Stone, or its impregnation (for preservation) with a "hard flinty substance," still continues to be the subject of rival claims to priority of invention, more particularly as regards the somewhat conflicting claims of Mr. Frederick Ransome and Mr. Szerelmy, both of whose processes would appear to have a similar object; namely, the effectual protection of stone, &c., from the ordinary ravages of decay through damp.

Red Lead, in very general use for coating Iron Vessels, tanks, &c., is now declared, on good chemical authority, to be most pernicious and destructive in its action upon the metal. The red-lead coating gets covered with blisters, from each of which, on being opened, a clear fluid escapes, and leaves exposed on the surface of the iron, a number of brilliantly-shining crystals of metallic lead. Each blister is on the new theory—in fact, a galvanic battery in miniature; and, as wherever there is electrical there must also be chemical action, the corrosion is easily accounted for. This action will continue as long as any red-lead remains, and is necessarily at the expense of the iron. "Sweating" is due, in a great degree, to the use of red-lead paint, in immediate contact with iron. The above is the substance of a report on the subject, recently made to the managers of a large Steam Packet Company in Liverpool, by M. Lamont.

Phosphate of Lime (native) has been discovered in large quantities in Spain, at 4 leagues from the Mediterranean Railway. The announcement of this (agriculturally and otherwise considered) valuable natural deposit was made in a letter from M. Ramon de Luna, to the last sitting of the Paris Academy of Science.

Electric Clocks.—The Mersey Dock Board adopted (19th May ult.) a resolution in favour of the application of electricity to the clock on the summit of the Victoria Tower, Liverpool, in order to insure greater accuracy in the dropping of the time-ball on the top of the same tower.

ACCIDENTS FROM MACHINERY.

Mistaking a Jerk for a "Skip" Signal.—Several men working in the Limestone Pits, near Dudley, belonging to Lord Ward, were seriously injured (16th May ult.) by being drawn up over the pulley on which the rope runs communicating with the bottom of the pit. Whilst the engineer was in the furnace-hole, the engine, through a movement in one of the fore pits, gave a jerk; and seven men, who were all standing near the skip, in which they were to descend, thinking this movement in the engine was their signal, immediately got into the skip. The engine started at the same moment, drawing the skip over the pulley, and dashing the seven men to the earth with great violence. The weight of the men caused the second jerk, and started the engine; hence the accident, the blame of which is not attributable to the engineer, as the men, by mistake, got into the skip without the signal.

Fatal Accident at a Lime-kiln.—A most appalling accident occurred (16th May ult.) at the Llwydcod Limekilns, near Aberdare. A workman, while superintending the process of burning lime, and having "fed the kiln," *i.e.* piled upon it a large heap of stones, &c., got to the top of the heap to level the stones. The mass beneath was highly calcined; and the substratum giving way, the heap of stones slowly descended, and the unhappy man was carried with them into the burning abyss. In spite of all efforts to extricate him, or to render assistance, he was literally roasted to death; and when, the kiln having been as quickly as possible drawn, his body was recovered, it presented nothing, save a charred and blackened mass. Verdict—"Accidental death." At the inquest, it was represented that the "kindling the coal" was very dangerous, and often fatal; but that it was still obstinately persisted in.

Defective Tackle.—A fatal accident occurred (30th April ult.) at the Pimlico Slate Works (Messrs. Magnus and Co.), by which the foreman lost his life. Deceased was superintending a number of workmen in the removal of some very heavy slabs of slate, when some of the tackle gave way, the slates falling upon the deceased, who was underneath the platform. The falling mass (several hundred weight) crushed him to death upon the spot.

On the 9th May ult. a fireman, employed on board the screw-steamer *Laconia*, was killed by the breaking of the stage during the hauling on board of a screw-shaft, at the Sandon Graving-dock, Liverpool. Verdict—attaching blame to the first and second officers of the steamer, who had the management of the operation.

LIST OF NEW PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 3rd March, 1859.

572. W. Mitcalfe, Coal Exchange, London—Discharging cargoes, and in raising and lowering bodies.

Dated 5th March, 1859.

588. R. Leake and M. Sykes, Barnsley, Yorkshire—Furnaces for consuming smoke and generating heat.

Dated 9th March, 1859.

616. J. Cooke, Cheltenham—Apparatus for giving signals on railways and vessels.

Dated 16th March, 1859.

662. H. Ambler, Halifax—Breech-loading ordnance.

Dated 17th March, 1859.

680. A. Mein, St. Rollox, Glasgow—Making glass bottles.

682. J. Donat, 6, Rue Paradis Marais, Paris—Apparatus used with matches for obtaining instantaneous light.

Dated 19th March, 1859.

700. J. W. Hart, 60, St. Mary Axe, London—Apparatus for the destruction of flies and other insects.

Dated 22nd March, 1859.

722. W. Weild, Manchester—Machinery for coating slips, sheets, rods, and bars of metal with paints and varnishes.

727. D. L. Banks, Kennington, Surrey—Suspension rail or road ways.

734. J. Macintosh, North Bank, Regent's-park, and Major G. Rhodes, Regent-st. — Tents and coverings for shelter against the weather.

Dated 23rd March, 1859.

740. B. Browne, 52, King William-st., London-bridge—Working or operating switches and signals on railways by improved apparatus for that purpose.

Dated 26th March, 1859.

702. William Redgrave, Tavistock-st., Middlesex—Pillow travelling cap.
764. S. Dreyfous, G. Richer, and E. Cormier, Paris—Preserving eggs.

Dated 29th March, 1859.

778. T. Carr, Bebington, Chester—Machinery for disintegrating artificial manures.
779. C. L. Roberts, Clerkenwell—Cigars.
781. J. W. Kelly, Ennis, Ireland—Gas burners.
782. E. D. Caranza, 97, Rue des Petits Champs, Paris—A new system of gas-lighting.
783. E. N. Normington, 19, High-st., Camden-town—Re-manufacturing of old used dirty railway grease for the manufacturing of new railway grease, for the cleansing and re-manufacturing of old used cotton waste, tow, or any textile fabrics.
785. R. Searle, Woodford Wells, Essex — Apparatus for transmitting signals by electricity for telegraphic purposes.
786. I. Spight, Glandford Briggs, Lincolnshire—Horse-shoes.
787. T. Taylor, Vere-st., Middlesex — Giving increased strength to paper.
788. H. P. Burt, Charlotte-row, Mansion-house—Apparatus for preparing and preserving timber.
789. H. Moss, 62, Brill-row, Somers-town, and T. West, 5, Jewin-st.—A machine for the cutting of leather for every purpose.

Dated 30th March, 1859.

790. W. Brown, Bolton-le-Moors, Lancashire—Manufacturing clog soles.
791. J. H. Linsey, 103, Cheapside—Binding or covering books.
792. J. W. Hadwen, Kebroyd Mills, Halifax—Manufacture for converting certain kinds of silk waste into yarns or threads.
793. W. V. Edwards, Swindon, Wiltshire—Construction of ways and apparatus to facilitate the conveyance of mails, goods, and passengers.
794. G. T. Bonsfield, Loughborough-park, Brixton—Preventing explosions in steam boilers.
795. T. D. Shipman, Toronto, Canada West, N.A.—Apparatus for stamping and printing.
796. H. Jefferies, Birmingham—Castors for furniture.
797. J. Cartwright, Shrewsbury—Implement for crushing clods.
798. C. P. Coles, R.N., Southsea—An apparatus for defending guns and gunners in ships of war.
799. W. Gossage, Widnes, Lancashire — Manufacture of certain alkaline silicates.
800. A. V. Newton, 66, Chancery-lane — Governor for steam-engines.
801. W. Smith, King-st., Smithfield, and E. Smith, Hamburgh—Apparatus for the purpose of regulating the passage of fluids.

Dated 31st March, 1859.

802. J. Lacy and S. Simpson, and H. Smith, Travis Holme Mill, Walsden, near Todmorden, Lancashire—Machinery for preparing and spinning cotton and other fibrous materials.
803. C. Pickering, Tonbridge, Kent—Apparatus for brewing.
804. R. C. Ross, Glasgow—Apparatus for cultivating land.
805. T. Ivory, Edinburgh—Rotary engines.
806. T. Ivory, Edinburgh—Steam boilers and furnaces for the same.
807. A. Morton, Morton-pl., Kilmarnock — Sextants or quadrants for nautical purposes.
809. J. S. Bateson, 17, Bolton-st., Mayfair—Generating steam.
810. F. Morton, James-st., Liverpool — Construction of fences and the posts or pillars for the same.
811. W. E. Newton, 66, Chancery-lane—Mills for cleaning rice.
812. A. V. Newton, 66, Chancery-lane—Construction of steam-boiler and other furnaces.

Dated 1st April, 1859.

813. D. K. Clark, 11, Adam-st., Adelphi—Feed-water heating apparatus.
815. I. Sigismund, Hull, Yorkshire—Manufacture of artificial teeth.
816. R. A. Brooman, 166, Fleet-st.—Solidifying, pressing, and moulding.
817. R. A. Brooman, 166, Fleet st.—Preparation of indigo for dyeing.
819. W. E. Newton, 66, Chancery-lane—Manufacturing sulphate of lead, carbonate of lead, and sulphate of soda.
820. J. J. Davis, Percival-st., Clerkenwell—An improved pad, applicable for inking and damping.
821. W. Tod, Glasgow—Marine steam engines.
822. Y. M. Thomas, 2, Rue St. Appoline, Paris—An improved propeller for ships and water wheels.

Dated 2nd April, 1859.

823. J. Desmet-Seaut, 4, South-st., Finsbury—Gasburning and lighting apparatus.
824. A. Ripley, 21, Bridge-st., Blackfriars, and J. Roberts' Nelson-sq., Bermondsey—Machinery for striking or scraping leather and hides.
825. J. Hall, Queen's-road, Chelsea, and J. S. Sparkes, St. John's-wood — Machinery for hoisting, lowering, pulling, or drawing weights.
826. A. Bessemer, Tavistock-terrace, Upper Holloway—Furnaces to be employed in the manufacture of iron and steel.
827. S. Desborough, 24, Noble-st.—Making up needles and steel pens.
828. J. Skertchley, Ashby-de-la-Zouch, Leicestershire — Apparatus for regulating the pressure of gas.
829. W. Mather, Manchester—Apparatus for catching and destroying flies and other insects.
830. A. Paget, Loughborough, Leicestershire—Apparatus for the manufacture of looped fabrics.
831. M. Scott, 26, Parliament-st., Westminster—Diving apparatus.
832. M. Coupland, Haggerstone, Middlesex—Furnaces.
833. T. Richardson, and G. W. Jaffrey, Hartlepool, Durham—Arrangements and construction of harbours of refuge, breakwaters, and other like structures.
833. C. F. Kirkman, Argyll-street, Regent-street—Manufacture of cocoa-nut fibre yarn.
834. T. Williams, Aberdaron, Caernarvon, and J. H. Fuller, 70 Hatton-garden—Screw stocks and dies.

Dated 4th April, 1859.

835. F. Potts and R. Brough, Birmingham—Manufacture of calico printing rollers or cylinders.
836. J. Eccles, Blackburn—Machinery for making bricks, tiles, and other articles formed of plastic materials.
837. C. F. Kirkman, Argyll-st., Regent-st. — Protecting telegraphic wires.
839. W. Brown and C. N. May, Devizes—Haymaking machines.
840. J. H. Burton, Enfield Lock, Middlesex—Manufacture of barrels for small fire-arms.
841. W. E. Newton, 66, Chancery-lane — Ladies' hooped skirts.
842. A. V. Newton, 66, Chancery-lane—Construction of retarding apparatus or break for railway carriages.
843. C. Russell, Stubbers, near Romford — Working of marine engines.
844. M. A. Crooker, New York, U.S.—Paddle wheels for steamers.
845. D. B. White, M.D., Newcastle-on-Tyne—Arranging ships' and other pumps.
846. E. Morewood, Enfield, Middlesex—Coating metals.
847. D. Sowden, Bradford, Yorkshire—Jacquard machines employed for weaving figured goods or fabrics.

Dated 5th April, 1859.

848. A. Shanks, 6 Robert-street, Adelphi, Westminster—Machinery for forging and stamping metals.
849. G. Hazletine, 4, Southampton-buildings, Holborn—Sewing machines.
850. E. Fairburn, Kirklees Mills, Mirfield—Machinery for carding wool and other fibrous substances.
851. L. Brierley, and H. Gearing, Birmingham—Improved method of ornamenting metallic bedsteads.
853. G. F. Chantrell and E. Dutch, Liverpool—Apparatus for regulating the quantity of water to be used for the flushing of water-closets.
854. B. Browne, 52, King William-st., London-bridge—Propelling ships or other vessels through water.
855. J. Hetherington, Manchester, and T. Webb and J. Craig, Tutbury, Derby—Apparatus for spinning and doubling cotton.
856. T. Scott, Dundee—Preparing, treating, or manufacturing fibrous materials.
857. N. Libotte, 33, Boulevart St. Martin, Paris—Apparatus to be applied to cages in the drawing of coals.
858. F. M. Crichton, Stoke Abbey, Stoke Bishop, Westbury-upon-Frym, Gloucestershire — Clocks or time-keepers.

Dated 6th April, 1859.

859. T. P. Luff, Shepton Mallet, Somersetshire—Cheese vats.
861. J. A. H. Ballande, Paris—Preparation of writing paper.
862. W. Owen, Rotherham, Yorkshire—Manufacture of railway wheels and tyres and the apparatus employed therein.
863. J. Rogers, 9, Queen-sq., Bartholomew-close, and E. J. Tweed, 22, Castle-st., Falcon-sq.—Coating conducting wires used for electric telegraphic purposes.
864. J. Scoffern, 4, Barnard's-inn—Lubricating projectiles and cartridges.

Dated 7th April, 1859.

865. D. Moseley, Chapel Field Works, Ardwick, Manchester—Manufacture of cards for carding cotton and other fibrous materials.
866. A. Chaplin, Glasgow, Lanark—Steam boilers.
867. R. Postlethwaite, Liverpool—Harness pads for horses.
868. R. Wardell, Stanwick, and H. Kearsley, Ripon, Yorkshire—Reaping machines.
869. G. Champney, Halsham, Yorkshire—Reaping machines.
870. John Laking, jun., Hall End, near Tamworth—A new or improved agricultural drill.
871. J. Garrett, Arundel-pl., Haymarket—Construction of goblets, jugs, and other like articles.
872. J. Rawlings, Carlton-hill East—Improved construction of boot-tree.

Dated 8th April, 1859.

873. J. T. Pitman, 67, Gracechurch-st., London—Construction and use of fireworks for signals.
874. W. H. Smith, Philadelphia, U.S.—Construction of cartridges.
875. J. Bindley and J. Hinks, Birmingham — Rotatory steam-engines and pumps.
876. William Campion, Nottingham—Machinery for the manufacture of looped fabrics.
877. M. Wheeldon, 174, Liverpool-rd., Burslem, Staffordshire—Looking glasses and mirrors.
878. M. A. F. Mennons, 32, Rue de l'Echiquier, Paris—An improved articulated joint for water, gas, and steam pipes.
879. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Treatment of mineral phosphates of lime.
880. N. A. Grumel, Paris—Dying cotton, wool, and fibrous materials.
881. W. Hooper, Mitcham, Surrey—Insulating and protecting telegraph conductors.
882. W. Hooper, Mitcham, Surrey — Re-manufacturing compounds of india rubber and sulphur.
883. W. Henderson, Alderley Edge, Cheshire—Treating certain ores and obtaining products therefrom.
885. E. R. Handcock, 23, Norfolk-st., Strand—Steam and other motive power engines.

Dated 9th April, 1859.

886. T. Spencer, 192, Euston-rd., Euston-sq.—Economical treatment of refuse or waste matter containing sulphur.
887. E. J. Hughes, Manchester—Manufacture of woven fabrics.
888. T. Barnett, Oldham, H. T. Sourbuts, and W. Loynd, Hyde—Steam engines.
889. J. H. Young, 66, Great College-st., Camden-town—Setting-up (composing) and distributing types.
890. J. Hawkins, Lisle-st., London—Manufacture of stirrups, bits, spurs, buckles, and articles connected with harness.
891. J. H. Johnson, 47, Lincoln's-inn-fields—Production of the ferrocyanide and cyanide of potassium.
892. R. J. Derham, 46, Redcliffe-st., Bristol—Cheese vats.
893. J. Martin, 4, Buckingham-st., Islington—Manufacture of bonnet-fronts and ruches.
894. C. F. Vasserot, 45, Essex-st., Strand—A new motive power applicable to tanneries.
895. W. E. Newton, 66, Chancery-lane—Steam-engines and boilers.
896. H. F. Gardner, Boston, U.S.—Machinery for blocking or crimping the uppers of boots and shoes.
897. R. Brown, 5, St. Paul's-churchyard—Apparatus for warming buildings.

Dated 11th April, 1859.

898. B. Baugh, Bradford-street, Birmingham—Working fly presses by steam or other power.
899. R. Wappenstein, Manchester—Apparatus for spinning and doubling fibrous materials.
900. W. Schofield, 13 Thomas-st., Stamford-st., Blackfriars-road—An improved effervescing lemonade.
901. J. Anderson, Liverpool—Construction of the furnace of bakers' ovens.
903. L. Wimmer, Vienna, Austria—An improved preparation for killing beetles.
904. A. Bower, Liverpool—Keels of navigable vessels.
905. W. Rowan, Belfast—Spinning flax, hemp, and other fibrous materials.
906. R. A. Brooman, 166, Fleet-st.—Candle moulds.
907. W. S. Clark, Aberdare, Glamorganshire — Loading ships or vessels with coal.
908. W. H. Barlow, Great George-st., Westminster—Beams and girders.
909. J. Marland, Southport, Lancashire—Manufacture of cop tubes.

Dated 12th April, 1859.

910. Lieut. W. Clark, R.N., Langhaugh, Galashiels, Scotland—Improved safety block to be used for lowering ships' boats.
911. D. Doig, Manchester—Construction of gas lamps.
912. P. Aitchison, Sheffield—Taps.
913. G. J. Johnston, Ashley, Cambridgeshire—Drills for drilling of corn, seeds, and manure.
914. E. T. Noualhier, Paris—An improved ventilator.
915. W. E. Newton, 66, Chancery-lane—Manufacture of iron.
916. P. Hill, Manchester, and J. Moore, Salford—Weaving double pile fabrics.
917. C. Burrell, Thetford, Norfolk—Apparatus for screening corn and seeds.
918. M. Castay, Paris—Metallic bridges.
919. J. Crossdale, Rotherfield-st. lower, Islington—Boots and shoes.
920. J. Ward, King's Norton, Worcestershire—Working fly presses used for raising metal.
921. R. A. Brooman, 166, Fleet-st.— Preparation of red dyes.
922. S. Tatton, Leek, Staffordshire—Preparing and treating silk.

Dated 13th April, 1859.

923. R. Emery, 6, King-st., St. James's-sq.—Carriages for common roads.
924. W. A. Martin and J. Purdie, Woolwich—Fire-bars.
925. H. Eckhorn, 24, Cranbourne-st., Leicester-sq.—Regulating the production of light in lamps.
926. R. Coleman, Chelmsford—Agricultural implements.
927. J. Apperly and W. Clissold, Dudbridge, Gloucestershire—Fulling machine.
928. W. Craft, 12, Cambridge-road, Hammersmith, and T. Wilson, Bradmore House, Chiswick—Manufacture of pinafores and bibs for children.

929. A. R. Johnson, St. John's-wood—An instrument for damping, severing, and affixing postage and other like stamps.
930. J. A. Coffey, 4, Providence-row, Finsbury—Apparatus for heating liquids.
931. W. A. Gilbee, 4, South-st., Finsbury—The axles of railway and other carriages.
932. J. L. Stevens, 1, Fish-st.-hill, London—Fire grates of locomotive, marine, and other furnaces.
933. J. Hughes, W. Williams, and G. Leyshon, Brockmoor works, Brierley-hill, Staffordshire—Manufacture of tin and terne plates.

Dated 14*th April*, 1859.

934. J. Gillett, Upper Brailes, Warwickshire—Mill used for grinding and crushing.
936. T. Bird, Manchester—Application and use of a certain natural product or products in the manufacture of pickers for looms.
937. H. C. Coulthard and J. Jordan, Blackburn, Lancashire—Steam-engines.
938. J. Beattie, Lawn-place, South Lambeth—Means of preventing locomotive engines and carriages in motion on railways leaving or running off the rails.
939. E. Partridge, Stourbridge, Worcestershire—Construction of 'pipe' boxes for cart and waggon axles.
940. W. Barnes and S. Pickering, 127, Brick-lane, Spitalfields, and J. Roberts, William-st., Limehouse—Retarding and stopping railway locomotives and trains.
941. E. Dowling, Little Queen-st., Holborn — Scales or weighing machines and balance weights.
942. W. Sinnock, Brompton—Submarine and subterranean electric telegraph cables.
943. A. McDougall, Manchester—Coating metallic surfaces.
944. L. J. Higham, New York, U.S.—Billiard tables.
945. S. Barnwell, Coventry, and A. Rollason, Birmingham —Manufacture of umbrellas, parasols, and hats or hat covers.

Dated 15*th April*, 1859.

947. W. A. Gilbee, 4, South-st., Finsbury—Construction of buffers for railway and other carriages.
948. J. Chapman, Wolverhampton—Manufacture of angle iron.
949. G. Ashcroft, Cardiff—Working presses and other hydraulic machines.
950. R. Boot, Hill-street, Surrey—Treating sheep or other pelts, so as to give them the appearance of rough calf.
951. H. A. Silver, Cornhill—Insulating wire for electric telegraphs.

Dated 16*th April*, 1859.

952. H. Barrow, Birmingham—Fastening for fastening trunks, boxes, and articles of dress.
953. T. White, Edgbaston, near Birmingham—Frames or stands for holding liquor bottles, pickle jars, cruets, and castors.
954. J. Glasgow and S. Hand, Manchester—An improved variable circular motion applicable to slotting, shaping, and planing machines.
955. L. Collier, Rochdale—Feeding apparatus.
956. W. Clark, 53, Chancery-lane—Apparatus for separating metals from their ores.
957. E. Newton, 66, Chancery-lane—Manufacture of alumina.
958. J. Hamilton, 8, Exchange-square, Glasgow—Apparatus for regulating prime movers driven by water.
959. A. Courage, Bagillt, Flint—Obtaining the metallic particles contained in fumes or vapours from lead and other smelting works.
960. H. Harrison, Blackburn, Lancashire — Looms for weaving.
961. J. Sidebottom, Broadbottom, near Mottram, Chester—Construction of tubes and partial tubes, and machinery for placing them on the spindles of machines used in spinning.
962. H. H. Vivian, M.P., Swansea—Smelting copper.
963. N. Kenward, Sutton, Surrey—Machinery for obtaining motive power by fluids.
964. G. B. Cornish, New York, U.S.—Fog horns.
965. W. Walker, Liverpool—Rocket guns.
966. J. Moule, Seabright place, Hackney road—A new compound liquid for illuminating purposes.

Dated 18*th April*, 1859.

967. J. Luis, 1B, Welbeck-street, Cavendish-square—Machine for raising water.
968. R. Warry, Chatham — Breech-loading ordnance and its projectiles.
969. W. Prosser, 24, Dorset-place, Dorset-square—Production of light.
970. G. Porter, London—Valves or cocks.
971. J. Whitaker, Bedford Mill Iron Works, near Leigh, Lancashire—Mowing machines.
972. J. Seaman, Linslade, Buckinghamshire—Agricultural implements for working or cultivating the soil.
973. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—An improved disinfecting compound.
974. J. C. Wilson, Wood-street, London — A reversible shawl cloak.
975. J. Izod, 58, High-street, Hoxton, Middlesex—A safety cigar, vesuvian, or fusee box or case.
977. J. Freer, Rothley, Leicestershire—Machines for planting grain and seed.
978. J. Morton and S. H. Morton, Sheffield—Hearth-plates or ash-pans.
979. A. Dalrymple, Sheffield—Mode of covering crinoline.
980. G. Coller, Harlow, Essex—Mowing machine.
981. F. Edwards and W. Edwards, Coventry—Looms for weaving ribbons.
982. W. Parsons, Pontar-Tawe, near Swansea—Preparing sheet-iron and other metal sheets for japanners and other uses.
983. J. Boydell, Gloucester-crescent, Regent's-park—Apparatus applied to the wheels of locomotive traction and other carriages to facilitate the draught.

Dated 19*th April*, 1859.

985. P. Reynolds and J. Reynolds, Belfast, Antrim, Ireland—Apparatus for hackling flax and other fibrous materials.
986. C. Batty, Manchester — Apparatus for effecting instantaneous communication on railways between passengers and officials.
987. I. Dutton, Tipton, Staffordshire, R. Martin and T. Phillips, Dudley, Worcestershire—Machinery for preventing accidents in coal or other mines, by the drawing of skips or cages over their pullies.
989. O. Maggs, Bourton, Dorsetshire—Cheese presses.
990. J. W. Matthews, High street, Poplar—Manufacture of hats.
991. A. V. Newton, 66, Chancery-lane—Machinery for weaving seamless bags.

Dated 20*th April*, 1859.

992. Q. Beck, Belfast—Stoves.
993. J. Wotton, Birmingham—Raising or shaping metals.
994. J. M. Johnson and E. Johnson, Castle-st., Holborn—Production of ornamental surfaces suitable for advertisement tablets, plates for shop fronts, and for other uses.
995. A. W. Williamson, University College—Obtaining extracts from the liquorice root.
996. H. Rawson, Leicester—Machinery for combing wool and other fibres.

Dated 21*st April*, 1859.

999. A. F. Vanhulst, Brussels—Kiln for drying malt.
1000. E. Cottam, Pimlico—Apparatus employed for cutting or sawing metals and other substances.
1001. T. Dawson and J. Avery, 32, Essex-street—Pencil-cases, watch seals and keys, toothpicks, and other like articles of jewellery.
1002. J. Napier, Partick, near Glasgow—Producing figures or representations upon glass.
1003. J. Alison, Hainault Forest, Essex—Instrument for extirpating thistles and deep-rooted weeds.
1004. J. Davies, Tetbury, Gloucestershire—Apparatus for ringing door-bells.
1005. D. Auld, Glasgow—Apparatus for supplying steam boilers with water.
1006. R. A. Brooman, 166, Fleet-street—Knitting frames.
1007. E. Lewthwaite, Halifax, and G. Ambler, Queenshead, near Halifax—Clocks, watches, chronometers, and other timekeepers.
1008. E. Clark, New York—Sewing machinery.
1009. G. Roberts and J. Bridges, 20, Ponsonby-place, Vauxhall Bridge-road—Manufacture of candles.
1010. S. Truss, Darlington, Durham—Construction of pipes.
1011. J. H. Pepper, Morton-house, Kilburn Priory —Apparatus for showing stereoscopic pictures.

Dated 23*rd April*, 1859.

1013. R. Gray, Sheffield—Crinoline skirts.
1014. C. Mansel, Plymouth—A folding travelling-case.
1015. J. Edwards, 77, Aldermanbury — Manufacture of buttons.
1016. J. Armstrong, Sunderland—Drying and preserving timber
1017. J. Gillies, Glasgow—Branding or marking wood for casks and other purposes.
1018. J. Angus, Glasgow—Saddles.
1019. W. Dicks and W. Hopwell, Leicester—Machinery for making screws.
1020. P. L. M. Debain, Paris—Transmitting motive power to ships.
1021. P. F. Mutel and L. H. Blanchard, Paris—Gas burners.
1022. P. L. M. Debain, Paris—Making heat subservient for producing motive power.
1023. W. Gibson, St. Leonard's-road, Middlesex—Steering apparatus
1024. R. A. Brooman, 166, Fleet-street—Manufacture of woollen cloth.
1025. J. Marshall, jun., Selby, Yorkshire—Filtering and depurating fluids.
1026. W. Moxon, Parliament-street, Westminster, and J. J. Bennett, Homer-terrace, Victoria-park, Middlesex —Apparatus for raising and lowering heavy bodies.
1027. F. C. Maguire, Stamford — Utilisation of sewage manure.

Dated 25*th April*, 1859.

1028. W. Stevenson, Johnstone, Renfrew, N.B.—Manufacturing cotton and other fibrous materials.
1029. W. P. Palfern and M. McKay, Hammersmith—The manufacture of sweet figged soft soap
1030. J. Higgin, Manchester—Treating madder and plants of the same family.
1031. G. Ward, Blackburn—Apparatus for making healds.
1032. J. Owen and H. Duckworth, Blackburn—Apparatus for leasing yarns.
1033. T. A. Weston, King's Norton, Worcestershire—A new or improved pulley
1034. T. Buckham, Gloucester—Railway switches.
1035. J. Holmes, Street, Somerset—Applying eyelet holes to boots and shoes and in binding boots and shoes.
1036. A. W. Gadesden, 56, Leman-street, Goodman's-fields —Producing solution of sugar.
1037. E. Humphrys, Deptford—Steering apparatus.
1038. W. E. Newton, 66, Chancery-lane—Sewing machines.
1039. H. C. Hurry, Wolverhampton—Apparatus for obtaining motive power.
1040. W. Warne, J. A. Fanshawe, J. A. Jaques, and T. Galpin, Tottenham — Compounds applicable for packing the joints of steam or other pipes.
1041. S. L. Taylor, Cotton-end, Bedfordshire—Improvement in agricultural implements in obtaining motive power for actuating such implements.

Dated 26*th April*, 1859.

1042. T. Holt, Lower-place, and J. Brown, Oxford street, Well Field, Rochdale—Apparatus for heating water for the supply of steam boilers.
1043. H. Almann, Mornington-place, Hampstead-road — Construction of window-blind mountings.
1045. W. E. Newton, 66, Chancery-lane—Manufacture of nitric acid.
1046. R. Main, Birkenhead—Wheels for carriages.
1047. W. Marshall, Leith-walk, Mid-Lothian, N.B.—Steam engines.
1048. R. A. Brooman, 166, Fleet-street—Vulcanising and colouring caoutchouc.
1049. R. A. Brooman, 166, Fleet-street—Steam boilers.
1050. J. H. Johnson, 47, Lincoln's-inn-fields — Apparatus for combing wools.
1051. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for grinding and polishing knives and other articles of cutlery and tools.

Dated 27*th April*, 1859.

1052. J. M. Ciroux, Brussels—Lamp glasses and shades.
1053. G. Pearson, Bugbrook, near Weedon, Northamptonshire—Apparatus for cutting and shaping trenails.
1054. J. Hyde, Hollingworth, near Mottram, Chester—Steam boilers.
1055. H. R. Fanshawe, 13, Russell-place, Old Kent-road—Mechanism for drawing off, filtering, and guaging liquids in butts, casks, and such like vessels.
1057. J. R. Smith, Glasgow—Obtaining motive power.
1058. R. J. Laing, Haggerstone, Middlesex—Wet gas meters.
1059. C. Hamp, Harrow-road—Locks.
1060. J. Holroyd, Leeds — Machinery used for finishing woollen and other cloths.
1061. T. Lacey, Grafton-st Westminster—Gas regulators.
1062. Sir T. T. Grant, K.C.B., Chester terrace, Regent's-park—Ships' cooking apparatus.
1063. T. Gauntley, sen., High Pavement, Nottingham — Manufacture of fringes.

Dated 28*th April*, 1859.

1066. R. Jones, New Kent-road, Surrey—Safety lamp.
1068. N. Libotte, 33, Boulevard St. Martin, Paris—A steam brake for mines.
1072. J. Wheat, Hinckley, Leicestershire—Drilling machines employed for agricultural purposes.
1074. A. Boyle, Birmingham—Manufacture of certain parts of umbrellas and parasols.

Dated 29*th April*, 1859.

1078. H. Bosshard, Paris — An improved mechanism for obtaining and imparting motive power.
1080. S. de Cazenave, 189, Regent-street — An improved lubricating compound.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

860. I. Adams, Massachusetts, U.S.—An improved tubular chain cable guide for vessels' bulwarks.—6th April 1859.
997. L. P. Porter, New York—Knitting machinery—20th April, 1859.
935. J. Luis, 1B, Welbeck-st., Cavendish-sq.—A new cooling apparatus for liquids, especially beer.— 14th April, 1859.
988. A. W. Williamson, University College, London — Making extracts from liquorice root.—19th April, 1859.
1075. W. M. Cranston, 11, New Broad-street—A grass-cutting machine.—April 29th.
1110. J. Morse, Massachusetts, U.S.—An improved power printing press.—May 3rd.
1111. L. R. Blake, Massachusetts, U.S.—Machine for sewing a sole on a boot or shoe.—April 3rd.
1158. J. Luis, 1B, Welbeck-street, Cavendish-square— A self-regulating horse machine.—9th May, 1859.
1161. G. G. Bussey, 485, New Oxford-street—An improved contrivance for carrying cartridges and to facilitate using them.—9th May, 1859.

DESIGNS FOR ARTICLES OF UTILITY.

4165. April 14. William White Rouch, 180, Strand, W.C., "Photographic Portable Dark Operating Tent."
4166. „ 20. Howard Ashton Holden, Birmingham, "Roof Lamp for Railway and other Carriages."
4167. „ 21. George Henry Ellis, Malton, Yorkshire— "Washing Machine and Churn."
4168. „ 27. John Young, Vulcan Foundry, Ayr, "Parts of an Apparatus to be used in Sowing Mangold-Wurzel or Turnips."

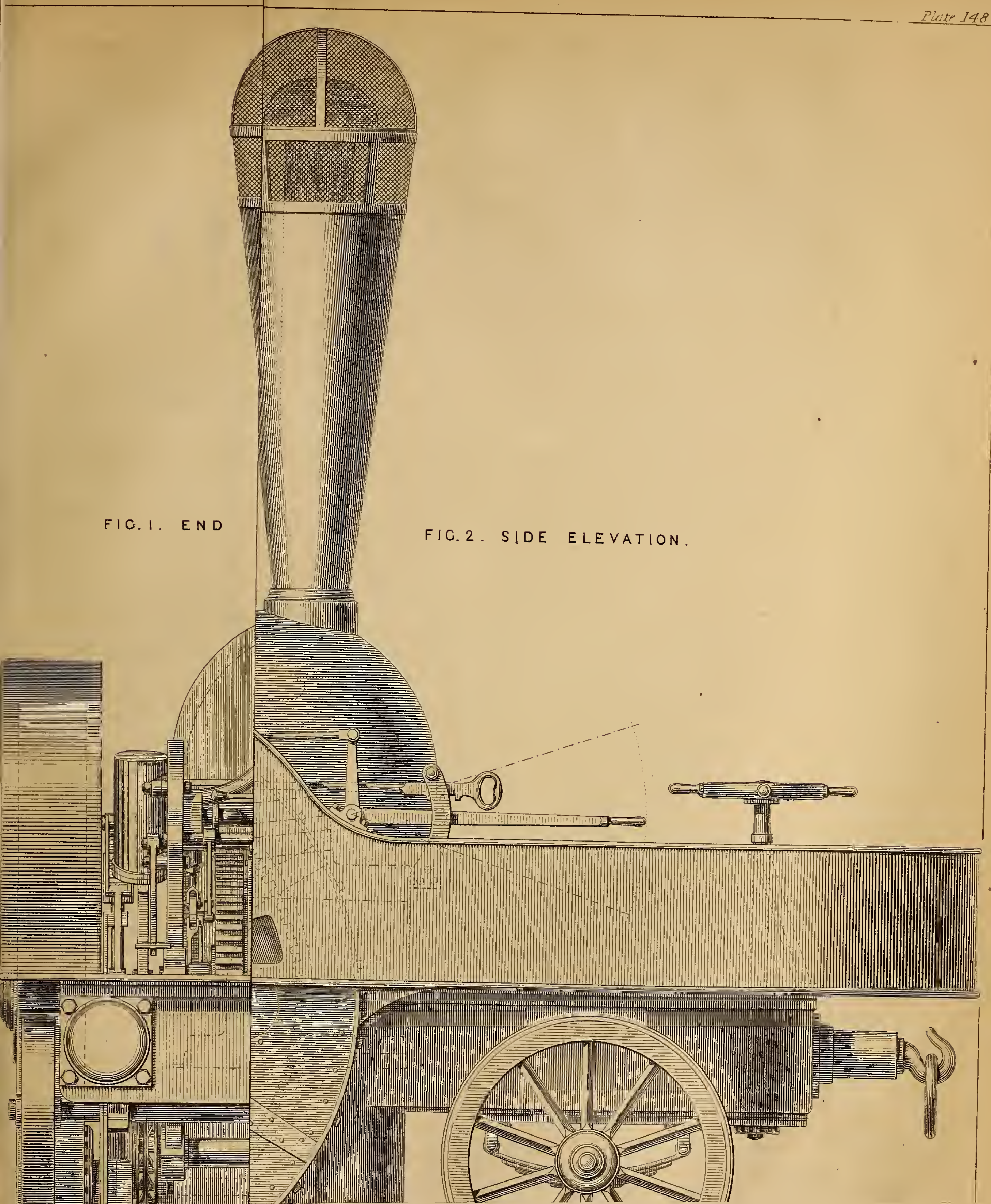


FIG. 1. END
FIG. 2. SIDE ELEVATION.

PATENT PORTABLE OR TRACTION ENGINE.

BY JAS. TAYLOR, ENGINEER.

BRITANNIA WORKS, BIRKENHEAD.

Scale ¾ Inch to 1 Foot

FIG. 1. END ELEVATION.

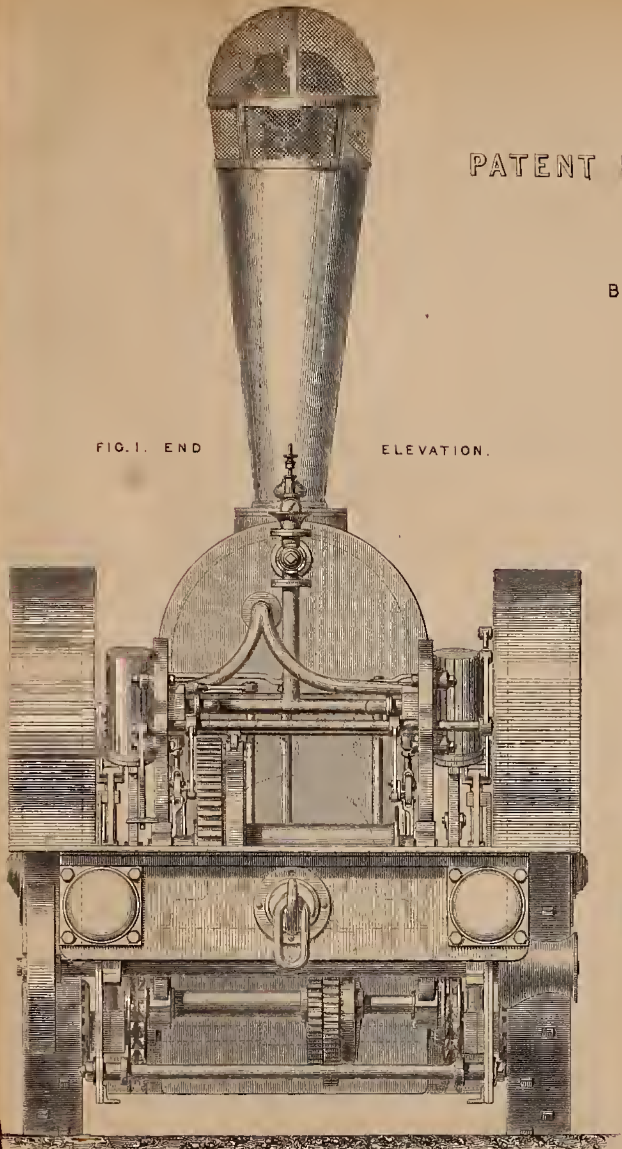
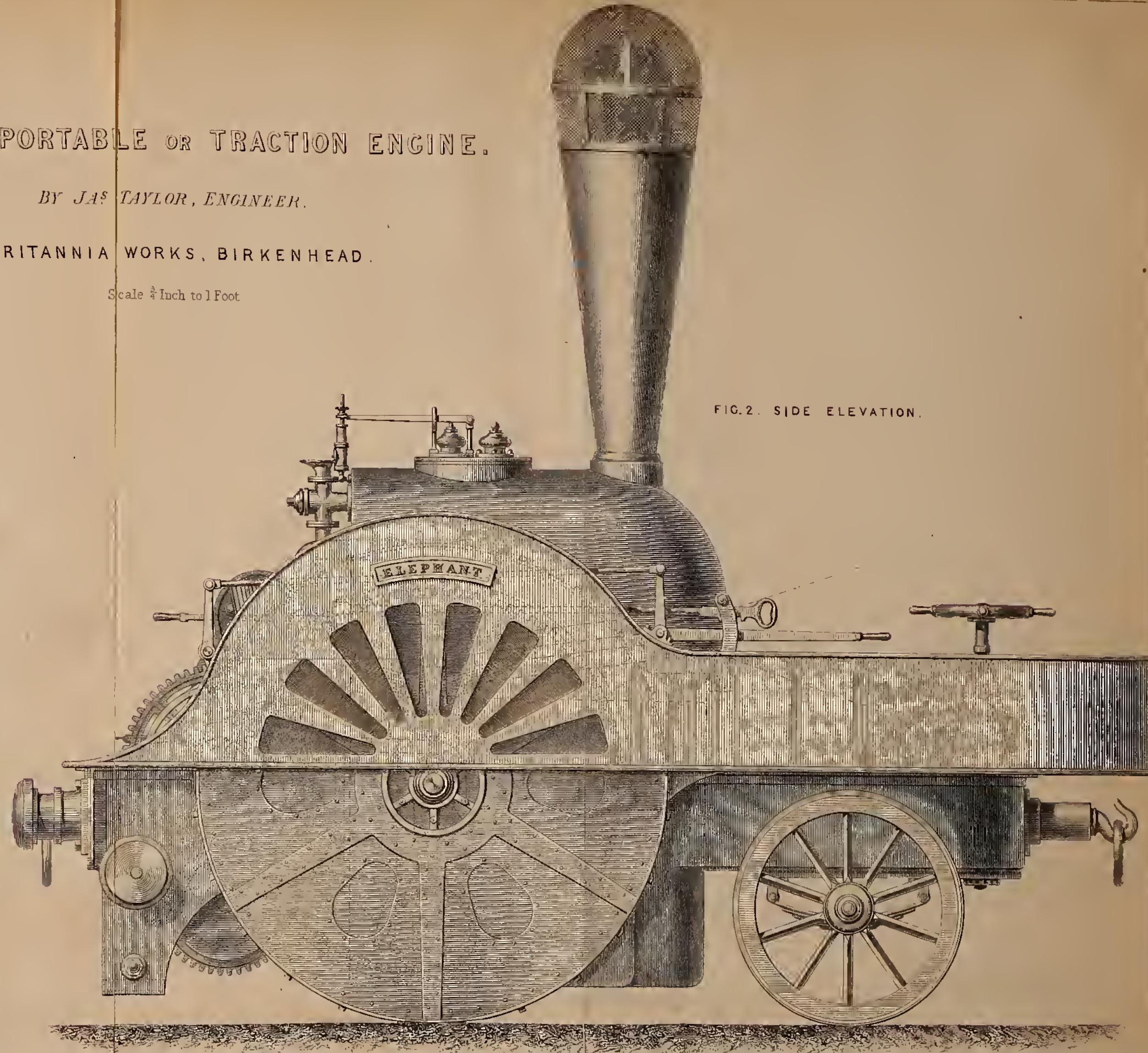


FIG. 2. SIDE ELEVATION.



THE ARTIZAN.

No. 198.—Vol. 17.—JULY 1st, 1859.

STEAM ENGINEERING IN 1859.

STEAM GENERATION (*continued*).

(Continued from page 139).

In our last number we referred briefly to the present efficiency of boilers used on land, and pointed out the wide margin still left for improvement; and as it is neither the intention nor object of these general observations to enter minutely into constructive details, we propose now, as briefly, to say a few words respecting the present efficiency of marine boilers.

When steam was first applied to the propulsion of ships, it was generated in large boilers with capacious internal flues, the pressure per sq.in. seldom exceeding 4 or 5 lbs. The advantages of this class of boilers are the ready access to all portions of the internal surface for cleaning, and their consequent durability, extending frequently to 8 and 10 years; their disadvantages are their weight, both of iron and water, and the great space they occupy in the ship. They have been, and still are, much used for tug-boats, and a few may be found in some of our largest first-class steamships.

To remedy the great weight and bulk of the flued boiler, the multitubular system was introduced, and it has now almost completely supplanted all other kinds of boilers for steamships, and although the particular arrangement of the present marine boiler may not be the best, it has nevertheless stood the test of a lengthened trial, and to a certain extent can be fully relied on.

To those practically acquainted with the construction of the boilers now in general use in our naval and merchant steam fleets, we shall be understood in describing them as those in which we have first the furnace, then the flame-box as a continuation thereof, then the tubes or flues returning over the furnace to the smoke-box; and, lastly, the uptake leading from the smoke-box to the chimney, and all, excepting the chimney, enclosed in the outer shell. This is the kind of boiler now generally adopted on board ship; in some cases, as in the *Great Eastern*, there are furnaces at each end of the boiler, leading into one flame-box, and having two sets of return tubes, leading to one or two chimneys as may be preferred. This arrangement, well proportioned, can be made the most effective of any, the only drawback being the necessity of having two stoke-holes—a matter of some importance in a small ship.

Adhering to the rule we have hitherto observed to avoid discussing exceptional cases, we will only allude in passing to the existence of two other kinds of boiler sometimes placed on board ship. In the one, we have, instead of return tubes, a series of vertical chambers, strongly stayed, and formed of $\frac{1}{4}$ in. plate. This arrangement has some advantages, one of which is stated to be that of durability. In the other design, introduced into several of the American mail steamships, the flame passes from the flame-box among a number of vertical tubes to the uptake, the steam being generated from the water in these tubes. We simply mention these exceptional arrangements, because they deserve to be noticed as having been proved by actual experience to be sound and practical.

We now return to the ordinary multitubular marine boiler as previously described, and generating steam generally at a pressure of from 15 to 25 lbs. per sq. in.; 30 lbs. per sq. in. appears to be the limit to which flat surfaces can be safely stayed, without crowding the stays so as to prevent easy access for cleaning and repair, and as also a rectangular form of shell wastes less space in the ship than a cylindrical, the former is almost universally adopted, and will, doubtless, be retained until the use of steam of higher pressure necessitates a different construction better calculated to resist the increased pressure.

The few accidents from explosion that have occurred in British steamships seem to show that as a general rule marine boilers have been constructed of sufficient strength for the pressure used, although this is no proof that the material has been well applied; indeed, it is matter of congratulation that we are not at present called upon to criticise the constructive details of a very large portion of our present marine boilers. We must, however, deprecate the common practice of attaching long stays intended to resist a strain of 3 tons to one side only of a single angle iron by a badly fitting bolt of $1\frac{1}{4}$ in. or $1\frac{1}{2}$ in. diameter; as also the system adopted in many large works of plating boilers without reference to the position of the stays, as though they could be shifted anywhere to suit the seams.

In no branch of mechanical engineering has such a want of science and constructive ability been displayed as in the designing and construction of marine boilers; and at the present time the bulk of our locomotive boilers have the longitudinal joints of the barrels only singly riveted, although it is known that an additional row of rivets would increase the cost but slightly, add some 14 per cent. to the strength of the barrel, and enable the weight to be reduced. It is very questionable if a late explosion and consequent loss of life would have occurred if the system of double riveting had been adopted.

The very best engineering should be displayed in the mechanical design and construction of boilers; and if an ignorant class of men are employed as foremen, the drawings supplied to them should be of the most complete and precise description.

In investigating the working efficiency of the present multitubular marine boilers, we are met at starting by a difficulty not experienced in land boilers—we allude to the use of salt-water, which not only causes a considerable waste of fuel, but renders it almost impossible to ascertain with any degree of accuracy the evaporative power of a boiler; and this element of uncertainty as to the duty realised has exercised a most baneful influence on the improvement of marine boilers in the mass.

Our standard works, too, on the steam-engine have greatly underrated the loss of fuel occasioned by the use of salt water, and constantly discharging into the sea a portion of the heat created by combustion in the furnace. It has been assumed that the loss of fuel referred to may be estimated by calculating the heat required to raise the extra feed supplied (to be afterwards blown into the sea), from its entering temperature to that at which it is discharged from the boiler; but observation and experience prove that both water and *steam* are discharged; and hence there is not merely the loss of sensible heat, as before estimated, but also a considerable loss of that latent heat in the steam, previously generated at a considerable expense of fuel. If this is not so, how is the fact accounted for, that in America, as the result of considerable experience in both fresh and salt-water boilers, it is found absolutely necessary to allow at least one-fourth more boiler power when salt water is used than when fresh, whilst many engineers allow even a difference of one-third?

We have then in ordinary practice, instead of a loss of some 10 or 12 per cent., as generally stated, a loss of at least 20 per cent.; and we have known instances where the loss of evaporative power, by changing from fresh to salt water, has amounted to 30 per cent.

If we are moderate, and take one-fifth as the actual loss, this alone is a serious drawback, when economy of fuel is of so much importance on board ship. There is without doubt considerable difference in the amount of loss by blowing out, according as the engineer in charge is more or less intelligent; for whilst on the one hand too much regard to economy may ruin the boiler, on the other, too much regard to avoidance of incrustation will result in needless waste of fuel.

We repeat, that in consequence of the inconvenience attending any attempts to ascertain the actual evaporation or economical efficiency of marine boilers, the most extreme views and practice have obtained, and almost without comment or criticism; no one knows with certainty the actual result of any particular arrangement or proportion, and, consequently, no one has the means of giving a standard for comparison.

Among several thousand boilers now in use, we find the greatest variety of constructive proportions, and as a natural result there exists a difference of 30, 40, and 50 per cent. in the evaporative power of boilers having equal heating-surface and fire-grate.

The amount of heating-surface and fire-grate allowed for a given nominal power varies 25 and 100 per cent. respectively, whilst the ratio between these two main elements varies fully 70 per cent. We are literally "at sea" in marine boiler engineering, nor do we seem to acknowledge practically that, except under special circumstances, there must be certain arrangements and proportions that will give the best result.

The first desideratum in all boilers is to obtain as perfect combustion of the fuel as possible, and experience has fully proved that, unless special arrangements are made for a supply of oxygen to the fuel, in addition to what is passed through the fire-grate, by a natural draught, and unless ample space is allowed in the furnace and flame-box for the products of combustion to combine, and maintain a high central temperature, the total heat resulting from combustion will be far short of what can be realised.

Now these are not opinions, they are proved facts—obvious to every unprejudiced practical engineer; and it is, therefore, difficult to explain why so many boilers are designed with proportions entirely at variance with these ascertained facts.

Seldom are efficient arrangements made for the required supply of air, and the furnaces are so contracted in height that the fuel almost touches the upper plates; and then, as the half-consumed products of combustion struggle along this comparatively cold-walled chamber, they pass into a flame-box (often only 16 in.) as contracted as the furnace; and when they traverse the small tubes the wasteful operation is completed, and results in a deposit of soot, and a most defective evaporation. This state of things exists in the bulk of our present marine boilers, and is discreditable to the reputation of British engineers.

An impartial consideration of comparative results in burning fuel in a boiler furnace appears to indicate that there should be a minimum height of 2 ft. between the fire-bars and furnace-crown, at the dead-plate, and a minimum length of 2 ft. to 2 ft. 6 in. in the flame-box.

Without presuming to pass judgment on the comparative merits of the various schemes for furnishing an extra supply of air to the furnace, for the purpose of effecting a more perfect combustion, and the consumption of smoke, we cannot but feel it is due to Mr. C. W. Williams to express the opinion, that his simple arrangements deserve the best consideration and confidence of practical engineers.

The vexed question of what description of coal is best for marine boilers is yet undecided, although of late years careful experiments have, to a certain extent, disproved the results arrived at by the Admiralty, and given in their three Reports; and we may add, that the public estimation of the value of the best North Country coal, for steam purposes, is greatly increased; and enough has been done to convince the unbiassed that, with certain arrangements of furnace, external smoke can be almost entirely avoided.

In supplying furnaces with fuel, it is to be regretted that the practice is so common of throwing the fresh charge of fuel to the back of the furnace, instead of keeping the fresh fuel supplied to the front near the dead plate, and, as combustion increases, pushing it towards the bridge. This latter system of firing, as well as others of a similar character, entails rather more work on the stoker, and hence is seldom adopted.

The arrangements generally introduced for the supply of air to the stoke-hole are of the most imperfect description, the cold air descending being met and obstructed by the hot air ascending, and this arrangement is adopted with the knowledge that the evaporative power of marine boilers is often seriously affected by a deficient supply of air to the stoke-hole.

If fault can be found with the present arrangements and proportions of furnace and flame-box, what shall be said of the varied dimensions of the return tubes? On the Thames we have $2\frac{1}{2}$, $2\frac{3}{4}$, and 3 in. tubes from 5 to $6\frac{1}{2}$ ft. long; on the Clyde we have from 3 to 4 in. tubes from 6 ft. to 8 ft. in length, and to estimate rightly the importance of these tubes, it must be remembered that they constitute about three-fourths of the total heating surface. Many a marine boiler has been spoilt by the introduction of badly-proportioned tubes. Then there is the question of what actual evaporative value a long tube has; from the results of some careful experiments it has been ascertained that about one-fifth of the length of the tube next the flame-box was equal in evaporative value to the flame-box itself, but that the remaining four-fifths were not together, equal in evaporative value to the one-fifth next the flame-box, and that the one-fifth next to the smoke-box was of very little use for generating steam.

Now, if these experiments are trustworthy, and we believe they are, they must modify considerably the prevailing opinions on the evaporative value of tube surface; and it may be conceded that practical experience with long small tubes has generally corroborated the conclusions to be drawn from them.

The practical difficulty that arises by the adoption of short tubes, is the necessity of increasing the number to obtain that heating surface which the shipowner expects to receive from the manufacturing engineer, and which he is not inclined to lessen, although with the improved arrangement it may be more effective.

In considering the question of diameter and length of tubes, there are two points to be noticed: first, the sectional area through the tubes being sufficient to receive and convey the expanded gases from the furnace without retarding the same; and, secondly, reducing the length of tube to a minimum consistent with the heating surface required, and the number of tubes that can be conveniently introduced.

It is not our wish to lay down the law on a subject so full of difficulty, but we can safely indicate in what direction we have erred, and what course should be pursued to remedy those errors.

An imperfect and sluggish combustion is the inevitable result of contraction in the sectiontial area through the tubes, and a waste of fuel is as inevitable where there is a deficiency of heating surface for a given rate and amount of combustion.

Numerous cases occur in daily practice in which both the above errors are existing, and are simply the result of defective information in the designer.

It is not unusual to find a difference of 25 per cent. in the areas of the chimneys of boilers of the same size and proportions;

considering that the heated products of combustion gradually cool and contract as they leave the tubes, and that the frictional surface is reduced from about 13 to 1, there can be no doubt that the sectional area of the funnel should be considerably less than that through the tubes; we find, however, frequent instances where the chimney is as large, and even larger in sectional area than the tubes.

Then who decides on the height of chimney? why, frequently even in large establishments the draughtsman who prepares the rigging plans, so as to make it look well with his spars, &c.; thus often a boiler that requires an unusually high chimney has a low one.

We have on a previous occasion referred to the connection always existing between the generating power of a boiler and the difference of temperatures between the escaping gases and the water to be raised into steam; a strong draft and rapid combustion making an effective, but not an economical boiler.

With a chimney of a given height—the draft being dependent upon the temperature of the escaping gases—when there is a large proportion of heating surface, a sharp natural draft and rapid combustion are not attainable.

As long as the rate of combustion is dependent upon heat escaping up the chimney, so long must the loss of that heat be submitted to; and if an artificial blast is substituted, and an attempt is made to absorb all the heat created by the combustion in the furnace, we shall still have this practical difficulty, that when the difference between the temperatures of the flues and water becomes, as it would in this case, very small, either a great increase of time must be given to complete the evaporation, or the ratio between the heating surface and the rate of combustion must be greatly increased.

The advantage to be derived from an artificial blast is the power to increase the rate of combustion *ad libitum*, and thus make a small boiler do the same duty as a large one; and, as a question of weight of boiler, such an arrangement is of great importance.

What are the practical deductions to be made from the preceding remarks?

We think there is sufficient evidence, of a thoroughly practical kind, to prove that attention to those arrangements and proportions we have shadowed forth will result in a considerably increased duty and economy.

With capacious furnaces and flame-box, an ample supply of air both in the stoke-hole and fuel, tubes *not exceeding* 5 ft. in length, and not less than 3 in. external diameter, a ratio of heating surface to fire-grate of not less than 40 to 1, and a rate of combustion from 16 to 22 lbs. of good steam coal per square foot of fire-grate, with such proportions 11 lbs. of water can be evaporated under atmospheric pressure by 1 lb. of coal.

When we compare such a result with the average duty realised at the present time, we feel we are justified in deprecating the present inefficient state of our marine boiler engineering, with its deficient supply of air, contracted furnaces and flame-box, badly-proportioned tubes and chimney, and an evaporative duty of only some 7 to 8 lbs. of water by 1 lb. of coal.

Unless surface condensation is introduced there appears little prospect of any extensive introduction of high-pressure steam into steamships, and we must be content for some time yet with a maximum pressure of 30 lbs. per sq. in.

If surface condensation ever becomes general, we may be quite certain there will be a considerable increase of the working pressure; but to design a boiler adapted for a steamship and capable of resisting a working pressure of 100 lbs. per sq. in., requires great care and experience: either the cylindrical form must be adopted or flat surfaces must be stayed, like the fire-box of a locomotive boiler; in either case it is impossible to allow of internal cleaning, so that any failure of the fresh water supply would be fatal to durability.

Although the block-ships and gun-boats fitted with high-pressure machinery, and working with salt water, are so seldom under steam, great inconvenience has resulted from the inability to keep the boilers free from incrustation.

If steam could be generated in small pipes, and their durability ensured, it would be a perfect high-pressure boiler, as 200 lbs. per sq. in. could be generated with as much safety as 20 lbs. in our present marine boilers.

We do not think there is any more hopeful branch of engineering than that connected with the propulsion of ships, nor any more likely to repay the improver. Necessity will ultimately oblige both steamship owners and engineers to economise fuel, and a truly satisfactory result can only be arrived at by the most laborious and persevering attention to the minutest details.

Connected with boiler engineering, the profession is much indebted to Mr. Fairbairn for data of a most valuable character; and there are many engineers of the present day who are helping to introduce great improvements. Our English exclusiveness militates greatly against a free interchange of practical experience among our leading engineers, and the young engineer must trust entirely to his own struggles for a position.

In the preceding remarks many points of interest in steam generation have been omitted, but with the excepting ordinary details, they will be referred to in the introductory observations on the application of steam as a motive power.

TAYLOR'S PATENT PORTABLE OR TRACTION ENGINE.

(Illustrated by Plate No. 148).

A considerable amount of attention has of late been devoted to the devising of steam engines intended to travel along highways, for the purpose of drawing trains of loaded trucks or waggons, and also for hauling loads or agricultural implements over soft ground,—Boydell's engine, with portable railway or truck, being one type of machine more particularly suited to passing over soft ground, and Bray's traction engine, with projecting teeth arranged around the periphery of each driving-wheel, being the other type best known and most suitable for ground of average hardness, though of varying character; but these engines have been designed solely for traction purposes, and are mostly intended for hauling loaded waggons or trucks, or for hauling agricultural machines. Now, Mr. Taylor, who is well known for the admirable steam winches, cranes, hoists, and such like labour-saving machines invented and constructed by him, has for some time past devoted himself to designing a portable steam engine, which shall be capable of running over ground of variable degrees of hardness, drawing loaded trucks or agricultural implements, and also for performing the duties of an ordinary portable steam engine for driving or rotating machinery, for raising and lowering heavy weights, and, by the application of a derrick or sheer leg, to perform the duties of a crane, besides containing within itself the means of performing various other descriptions of work, as that of a crab, winch, windlass, &c.; it may be employed for pumping water or as a fire-engine.

The engine is remarkably compact, and, unlike all of the traction engines which have preceded it, is mounted upon springs, and is capable of being turned in a circle of much smaller diameter than any other portable engine designed for the same purpose heretofore constructed, and this without having to resort to any disconnecting clutch or gear for throwing the one driving-wheel out, and also without any cessation of the transmission of the power of the engine through either driving-wheel.

The boiler, whilst it is short, gives plenty of steam, and is not liable to become injured when ascending or descending gradients, the water level within being but slightly affected by the steepest ascent or descent. The application of the American form of funnel and spark catcher is also a great improvement, and is very important for engines employed in agricultural work either in the stack-yard or elsewhere.

Plenty of coal and water space is provided in the fore part of the engine, and these weights are disposed low down. One man may attend to the fire, the engine levers, and gear, and also the steering-wheel, as the whole of the levers are so arranged as to be entirely within his control.

This engine has been repeatedly tried, and with uniform success, but we must defer for the present, from want of space, giving its performances, and entering into any further description or details of its construction.

SCREW PROPELLER—TRIALS ON BOARD H.M. FRIGATE "DORIS."

The following are some rough notes of the very interesting series of trials performed with screw propellers on board H.M. screw-frigate *Doris* in Stokes Bay; altogether, they are, without doubt, the most important trials which have been made since the *Rattler* experiments.

In presenting these few rough notes, we have to express regret that the official system of reserve and *red tapeism* existing in the steam department of the Admiralty renders it impossible, at least for the present, to do more in the way of presenting the results of these interesting trials more fully and in a more practically useful shape for the use of practical men; but we hope ere long all this will be changed, and that those who *pay* for these and such like experiments, and take a deep interest in the sound and rapid advancement of this important department of practical science, will have accorded to them free and unrestricted reference to the official records of trials of steamships in the Royal Navy; which records, however, to be of full practical value must be more ample, minute, and synchronal, and generally more systematic in their notation, than the generality of such records appear to be.

The engines are of 800 nominal H.P., constructed by Messrs. Penn and Son.

The draft of water, whilst under trial, varied but slightly, being generally about 19 ft. 6 in. forward, and 21 ft. 9 in. aft, but the exact mean draft was 20 ft. 6 in., which would give an immersed midship section, or section of greatest area, of 742 sq. ft., according to Admiralty measurement, but according to Messrs. Penn and Sons' measurement, they make the area 759 sq. ft. The pressure in the boilers averaged about 21½ lbs. per sq. in., whilst the mean effective pressure in the cylinders was 20 lbs. per sq. in., and the average vacuum was rather over 25½ in.; the number of revolutions of the engines and the indicated power varying with each alteration of the screw.

The first trial we have to notice was made April 21st with the common Admiralty two-bladed screw of 18 ft. diameter and 32 ft. pitch. Steam in cylinders, 20 lbs; vacuum, 26 in.; revolutions of engines, 53·25 per minute; mean of four runs, 11·823 knots; indicated power, 2921·2. The steering was very imperfect with this screw, the wheel being over 1¼ turns on the port side to keep the ship in her true course; vibration of ship noticeable.

The second trial was made May 5th with the former screw increased to 20 ft. diameter by the addition of 12 in. to each blade; steam in cylinders, 20 lbs.; vacuum, 26 in.; revolution of engines reduced by the increase of screw to 48·25 per minute; mean speed, 11·826 knots; indicated H.P., 2788·0. Carried her port helm 1½ spokes of the wheel over. The vibration of the ship, particularly in the stern-frame, was at least double that produced by the 18 ft. screw in former trial.

The third experiment was made May 9th with the last-mentioned 20 ft. diameter common screw, but the points of the blades were cut on the leading edge to an extent and in shape similar to Griffith's; the pressure in cylinders, 20 lbs.; the vacuum, 26 in., as before; revolutions of engines, 50 per minute; speed, mean of the six first runs = 11·978 knots; the mean of the six last runs 12·048 knots; the indicated H.P. during each set of six runs, 2884; the steering good; vibration greatly reduced.

The fourth trial was made May 23rd, the two edges of each blade being cut to an extent and in shape like Griffith's; the diameter being kept at 20 ft. The pressure in cylinders, 20 lbs.; vacuum, 25½ in.; revolutions, 51·8 per minute; mean speed of six runs, 12·012 knots. Indicated H.P., 2920·32. The steering perfect. Vibration further reduced.

The fifth trial was made May 25th, the former screw having been removed and its place supplied with a Griffith's patent screw of 20 ft. diameter, and 32 ft. pitch. The pressure in cylinders, 20 lbs.; the vacuum, 25½ in.; revolutions, 50 per minute; speed, 11·987 knots. Indicated H.P., 2825·6. Ship steered perfectly. No vibration.

The sixth trial was made May 27th, with Griffith's screw, same diameter, but the blades set at 26 ft. 6 in. pitch. Pressure of steam, 20 lbs.; the vacuum, 25 in.; revolutions increased to 58 per minute; speed, 12·266 knots. Indicated H.P., 3091. Steering splendidly. Neither vibration nor the slightest indication of the screw being in motion perceptible.

After these trials had been made, and demonstrating so thoroughly the merits of the Griffith's form of screw, and that the difference was in favour of the finer pitch, the Admiralty screw was again put on after being altered, and it was then tried against Griffith's screw set at a pitch between those previously used.

The seventh trial was made on June 1st, with the Admiralty screw, with the after part of the blade cut to Griffith's shape, the pitch being 32 ft., and the diameter 20 ft.; the pressure of steam in cylinders being 20½ lbs.; the vacuum 25½ in.; the revolutions 49·85 per minute; the speed 11·816 knots; the indicated H.P., 2850·4; steering moderately good; vibration about the same as in fourth trial.

The eighth trial was made June 3rd, with the Griffith's screw of 20 ft. diameter set at 30 ft. pitch. Pressure of steam, 20½ lbs.; vacuum, 25½ in.; revolutions, 53·710; speed, 12·158 knots; indicated H.P., 3009·03.

In noticing the relative performances of the Admiralty and the Griffith's screws, it is necessary to observe that the blades of Griffith's screw in this vessel have not been constructed to the best proportions, or, indeed, to those proportions which he follows in practice, in consequence of the screw frame and opening being originally made for an 18 ft. screw, and they would not allow the blades to be at the widest part near the centre more than 5 ft. 9 in., and 2 ft. 2 in. at point, instead of 6 ft. 8 in. and 2 ft. 2 in., or equal to one-third of the diameter of the screw in the widest part, near the root, and one-ninth at the point of the blades; which are the proportions Mr. Griffith usually follows.

Upon an early occasion we intend to compare the above results with previous experiments, and also with some other trials now in progress; in the mean time a careful consideration of the various points of difference connected with the applications of the screws in these trials, and the facts eliminated, will be useful to many, and of considerable interest to all concerned with the application of this form of propeller.

HER MAJESTY'S STEAM-SHIP "HIMALAYA."

It is worthy of record that this splendid iron screw steam-ship, now in her Majesty's service, during her last run home from the Cape, made the most remarkable steam performance ever attained in the annals of screw steaming, and this, too, notwithstanding the disadvantage under which the ship labours in respect of certain radical defects which exist in her machinery, from the inability to bear a higher and more economical steam pressure in the cylinders, and better vacuum in the condenser.

It is logged that this ship made the run between the Cape and Plymouth with 1,506 tons of coal, of only moderately good quality, indicating, during the time, 1,200 H.P., over an exact distance of 6,307 miles, if taken as a perfectly straight line, or as logged, and by observation, a distance of 6,397 miles, the pressure of the steam in the cylinders during the entire distance being rather less than 5 lbs. per square inch.

This not only shows good sailing or steaming, but excellent steering also, as the actual distance travelled is, if we mistake not, within 90 miles of the exact distance which would be measured on a straight line drawn between the two points.

The *Himalaya*, during five months, ran a distance of 25,452 miles, and carried 5,244 troops, and made one run of twenty-two days, under steam, working full power, without any intermission, and without either a hot bearing or any other cause of derangement or interruption whatsoever.

She is fitted with Griffith's patent screw propeller, of the good qualities of which the officers speak in the highest terms.

TRIAL OF THE RUSSIAN DESPATCH VESSEL "SOUKSSOU."

The *Soukssou*, is one of two despatch vessels, built by Mr. Pitcher at Northfleet Dockyard, for the service of the Russian Government.

At the trial, on the Thames, on Saturday the 4th inst., the results obtained were of an unusually satisfactory nature. The engines of the *Soukssou*, manufactured at the steam factory, Northfleet Dockyard, are on Harman's Patent Horizontal Direct Acting Principle, and were constructed and fitted on board under the superintendence of Mr. Charles Sage, from drawings executed by Mr. Edward A. J. Buckland.

The following is a summary of the principle dimensions, performance, &c. :—

	Ft.	in.
Length on load water line	121	10
Breadth on ditto	20	3
Draft on trial (mean)	9	3¾
Tonnage B. M.	269 tons	
Displacement at time of trial	288·5	
Area of immersed midship section at ditto	123·5 sq. ft.	
Nominal H.P. of engines	60	
Indicated ditto	253·7	
	Ft.	in.
Diameter of cylinders	0	28
Length of stroke	0	15
Diameter of propeller	7	9
Pitch of ditto	11	0
Length of ditto	0	19
Number of revolutions, mean	110	
Mean speed of ship in knots per hour	10	
Do. Do. propeller	11·93	
Slip ditto	1·93	
Do. ditto per cent.	16·1	
Nominal H.P. to mid section	0·486	
Indicated ditto	2·054	
Area of screw's disc, ditto	2·616	

Coefficient of locomotive duty by formula $\frac{V^3 a}{\text{Ind. H.P.}} = 486{\cdot}8$

Coefficient by formula $\frac{V^3 a}{\text{nominal H.P.}} = 2058{\cdot}3$

Weight on safety-valves in lbs. per sq. in., 20.
Mean vacuum in condenser = 25 in.
Mean steam pressure in boiler (at mile), 18 lbs.
Quantity of coal on board at trial, 38 tons.

The propeller is a double-threaded left-handed screw, 15¼ in. wide at boss, and 19 in. at periphery.

During the whole time of the trial there was an entire absence of anything like vibration, either in the engines of vessel, which in screw engines driven at high speeds is rather remarkable, while such a thing as a hot bearing was quite unknown.

The boiler of the *Soukssou* is of the multitubular description with brass tubes, it has a fire-bar surface of 54 sq. ft., and a total effective heating surface of 1246·10 sq. ft. = to 20·77 sq. ft. per nominal H.P.

ROYAL MAIL STEAM-PACKET COMPANY'S PADDLE-WHEEL STEAM SHIP, "THE PARRAMATTA."

THE trial trip of this vessel which took place 7th June, and which was considered very satisfactory, the vessel having made 14 knots per hour, has induced us to give the following particulars of her, which have kindly been supplied by Mr. Rennie, the well-known designer of the above Company, from whose designs and under whose superintendence she was built, at the Thames Shipbuilding Company's Works at Blackwall.

	Ft.	In.
Length on deck	339	0
Between perpendiculars	330	0
Breadth of beam	43	9
Depth moulded	35	0
Depth of hold from spar deck to ceiling	33	8
	Tons.	
Tonnage builders	3092 54/94	
Register Tonnage	2285	
Engines, nominal H.P.	800	
Indicator H.P.	2940	
	Ft.	In.
Diameter of cylinders	0	68⅛
Length of stroke of engines	9	0
Number of cylinders	4.	

Four tubular boilers and twenty-four furnaces.

The engines were made by Messrs. Maudslay, Sons, and Field; the boilers were constructed at the works of the Royal Mail Steam Packet Company, at Southampton, as also the wheels, which are feathering. The whole of the arrangements reflect the highest credit upon the designer and builders; and we must add that everything appears to have been done to make this vessel the most complete and most comfortable afloat. The size of her cabins, and the great regard to ventilation, so much required in vessels trading to hot climates, is a boon which will we are certain be appreciated by the passengers having occasion to make this route. She is a magnificent addition to this company's noble fleet of vessels. The *Seine* and *Shannon*, two other vessels now completing for this Company, will shortly be ready; the former was built at the Thames Shipbuilding Yard, Blackwall, and the latter has (both engines and vessel) been built by the same eminent firm, Messrs. R. Napier and Co., of the Clyde. Both *Seine* and *Shannon* are from the plans of the designer of the *Parramatta*, and are sister vessels.

SHIPWRECKS ON THE COASTS OF THE UNITED KINGDOM IN 1858.

IN our article in the last number of THE ARTIZAN (p. 140), we inadvertently stated that the number of shipwrecks on the coasts of the British Isles during the year 1858 was *Seventy*. It should have been 1,170! Of these 354 were total wrecks, 50 sunk by collision, making the number totally lost, 404; vessels stranded and damaged, so as to require to discharge cargo, 515; by collision, 251; making the whole number of wrecks 1,170; and the loss of life, as far as could be ascertained, 340. Let the reader think of these terrible realities, and say if the period has not arrived when England should put forth her strength to prevent, as far as possible, the total destruction of two or three millions worth of property lost every year on the shores and in the seas of the United Kingdom. Let the reader also consider the many that are made widows and orphans by these sad calamities. Thanks, however, to the energetic operations of the National Life Boat Institution, and to those of kindred bodies on the coast, we find that 1,555 persons were rescued from the 1,170 wrecks above detailed.

In a future number we shall probably return to this important subject.

ROWAN'S IMPROVEMENTS IN MARINE ENGINES, BOILERS, AND CONDENSERS.

WE have received the following particulars respecting Mr. Rowan's improvements in marine engines and apparatus, and to which we give insertion in the belief that too much attention cannot be given to the subject of coal economy in marine engines; and that whilst not more than some half dozen practical engineers connected with marine engineering are at the present time really devoting themselves to the subject earnestly and in the right direction, such examples as the present instance will serve very materially to spirit on others to follow up the experiments on a practically useful scale, and in a manner worthy of being recorded.

Mr. Rowan has, for several years past, devoted himself to the question of coal ecouomy in sea-going steamships, through the application of a higher steam pressure in the boilers, combined with cut-off and expansion in separate cylinders, and the employment of surface condensation and heated fresh-water feed. In his experiments, he has succeeded to an extent which, if after longer experience under the ordinary circumstances connected with long sea voyages on foreign stations, should prove to be practically attainable, he will have effected such an amount of coal-saving as has not yet been reached under the conditions stated; and could he always insure his fresh-water apparatus remaining in perfect working order, for the supply of his cellular and sheet space boilers, and by adding steam jackets to his low-pressure cylinders, there does not appear to us any material reason why the low rate of coal consumption per indicated H.P., which he gives as the result of short sea trips, should not be very closely maintained on longer trials.

The most vulnerable part of his plan, however, appears to us to be his boiler failing a full supply of fresh water, and thereupon becoming salted up, and this occurring when on a voyage to India, China, Australia, or South America, might involve serious consequences; but the ingenuity and perseverance which Mr. Rowan has already displayed in prosecuting this subject leads to the confident belief that he will suitably provide for such possible contingencies. The following are the particulars of the vessel and her machinery which recently appeared in the "Northern Times."

"Experiments with Mr. Rowan's marine steam engine have been made on a screw steamer (the *Thetis*) of the following size, fitted with engines of the nominal power of 100 horses:—gross tonnage, 580; and register, 380; length, 192 ft.; breadth, 26 ft. 6 in.; depth, 15 ft. 9 in.; capable of carrying 25 days' coals, and 650 tons of cargo. She was tried for ten hours, and ran at the rate of 9½ knots, on a consumption of fuel of 230 lbs. per hour, or say *two tons ten cwt.* per 24 hours. Practical men will acknowledge that this is less than one-fourth (if not quite one-fifth) of the consumption on board steamers with the ordinary marine engine. The first improvement of Mr. Rowan relates to the boiler, and consists in constructing it in a series of compartments, which constitute the main water space, aud are provided with tubes or tubular flues to pass through them. By these means steam-boilers, or generators of immense strength, and greatly increased evaporating power may be produced, not liable to explode from an undue pressure of steam, or, supposing such an accident to take place, capable of preventing any considerable damage, either to the boiler or attendants, occurring. The second improvement is in the condenser. The third improvement is in combining in the steam engine a high-pressure with two low-pressure cylinders. The boiler is worked with fresh water returned continuously from the condenser, and the economy is obtained principally by means of the very slow combustion of the fuel, as in the Cornish boiler, and by carrying expansion to a very considerable extent. To enable this to be done, there are on each engine three cylinders, the pistons of which are connected by a cross head, and move simultaneously. The centre cylinder, which is comparatively small, receives the steam direct from the boiler, on the upper side of the piston. After propelling the piston downwards, the steam is permitted to pass to the opposite side of the two large pistons, which are acted on solely by the expanding steam, and have no direct communication with the boiler. The object of having three cylinders is, to obtain equality of pressure and simplicity of arrangement, the general features of which are little different from an ordinary mercantile screw engine, or those of the common inverted cylinder engine. The surface condenser is used mainly for the sake of obtaining pure distilled water for the boiler, as it would not be safe to work with so high-pressed steam and salt water. Indeed, if salt water were used, the incrustation would soon put a stop to further proceedings. The boiler has been certified to be safer with 120 lbs. pressure than nine-tenths of the common marine boilers with 15 lbs., and it is not at all liable to get out of order. The crew required for engine room is the same, as regards engineers, as with an ordinary engine, but for a steamer of 100 to 150 H.P., only one fireman will be required for each watch, so that under this head there is a very considerable saving, apart from coals."

THE ROYAL MINT.

At the Mint, they are engaged in the production of a large quantity of copper coin for Ceylon, besides sustaining the pressure of a heavy order for similar material for home consumption. The Canadian Government, too, we have heard, are so well pleased with their new decimal bronze coinage of the cents, delivered at the beginning of this year, that they require twenty tons more forthwith. Truly there does not appear to be a prospect of much rest for men or machinery at the money-making establishment on Tower Hill. "Work on, work away," seems to be the motto there.

AMERICAN NOTES FOR 1859.—No. 4.

The following are a few notes of events interesting to the engineering profession occurring in the United States:—

The Philadelphia Press of April states that, on the 28th March, the steamers *Nathaniel Holmes* and *David Gibson* came in collision, near Petersburg, on the Ohio. The *Holmes*, which had a cargo of nails, iron, and general merchandise, sank instantly; the *Gibson*, which had on board 600 hogsheads of sugar, sank in a few minutes. Forty persons lost their lives.

From Philadelphia Press, April 4.—The boiler of the steamboat *Augusta* exploded on the Savannah River on the 1st April. Four persons were killed; and the boat, with a cargo of 780 bales of cotton and 540 barrels of flour became a total loss.

From Philadelphia Press, April 9.—The boiler at the Vulcan Iron Works, Baltimore exploded on the 8th, slightly injuring three of the hands, and doing about 1,000 dollars damage to the building.

From Philadelphia Press, April 14.—A verdict for 7,000 dollars has been obtained at Burlington, Vermont, against the Vermont and Canada Railroad Company, in a suit brought by the administrators of Mr. E. N. French, who was killed by the explosion of a locomotive on that road in July, 1855. The jury gave the verdict on the ground that the Company were guilty of culpable negligence in permitting the engine to be run when in an unsafe condition.—(Good for Vermont).

From Philadelphia Press, April 15.—Intelligence has been received that a train of cars on the Mississippi and Central Railroad has fallen through the tressle-work. Two men were killed and eight drowned.

From Philadelphia Press, April 26th. — The steamer *Contia Costa* exploded her boiler in Sau Francisco Bay on the 2nd April. Four men were killed.

From Philadelphia Press, April 27.—The steamer *St. Nicholas*, bound from St. Louis to New Orleans, exploded her boilers on the night of the 24th. The boat and cargo are a total loss. Fifty-two persons are killed and missing.

From Philadelphia Ledger, May 4.—On the 2nd May a locomotive engine exploded on the Pennsylvania railroad, near Greensburg. The engineer, fireman, and conductor of the train were killed, and the engine was blown completely to pieces. The engine had just been overhauled, and was in excellent order. The accident is attributed to the negligence of the engineer.

From Philadelphia Ledger, May 9th.—A large fire occurred at Pittsburgh on the night of the 7th, commencing on the steamer *Henry Graeff*. Nine other steamers were burnt before the course of the fire was arrested—namely, the *Panola, Jannie Gray, Council Bluffs, James Word, J. H. Corm, Potomac, Belmont, Cremonia,* and *Commerce*. None of the boats had much freight on board.

From Philadelphia Ledger, May 12th.—The *Winans Cigar Steamer* was tried again, at Baltimore, on the 10th, and with the wheel making fifty-six revolutions per minute, a speed of 14 miles per hour was attained. It is now contemplated, by Mr. Winans, to take off the bows and put on others, so that she will be sharpened, and also to cut her in two, and increase her length in the centre. Also to change the flanges of the wheel and continue the experiment until the object first intended is accomplished. (Mr. Winans must be a man of great pluck, and deserves success.)

From Philadelphia Ledger, May 14th.—A very destructive fire occurred at the locomotive depot of the Philadelphia, Wilmington, and Baltimore Railroad, in Baltimore, on the 13th, resulting in the destruction of five locomotive engines, and a portion of the machine shop.—Loss, 30,000 dollars.

From Philadelphia Ledger, May 19th.—A fine propeller steamer, the *Habanna*, was launched from the ship-yard of Messrs. Birely and Lynn, at Philadelphia, on the 18th. She is 160 ft. long, 28 ft. beam, and 12 ft. hold, and will be fitted with a direct-acting condensing-engine of 50 in. cylinder 33 in. stroke, by Messrs. Reaney and Neape.

Intended service—from New Orleans to Havanna.

DIMENSIONS OF STEAMER "PEI-HO."

Built by Thomas Collyer, New York; Engines by Morgan, Ironworks, New York.

	Ft.
Length on deck	225
Breadth of beam (moulded)	32
Depth of hold	9
Depth of hold to spar deck	16
Hull } Engine-room }	1,110 tons

Kind of engines, inclined oscillating; ditto boilers, return tubular; diameter of cylinders, 52 in.; length of stroke, 8 ft.; diameter of paddle-wheel over boards, 28 ft.; length of boards, 8 ft.; depth of ditto, 1 ft. 6 in.; number of ditto, 24; number of boilers, 2; length of ditto, 18 ft.; breadth of ditto, 12ft. 6 in.; height of ditto, 12 ft. 6 in.; number of furnaces, 6; breadth of ditto, 3 ft. 8 in; length of fire-bars, 7 ft.; number of tubes, above 336; number of flues below, 32; internal diameter of tubes, $3\frac{3}{4}$ in.; internal diameter of flues, 16, 14, and 10 in.; length of ditto, 12 ft.; diameter of chimney, 1 ft. 10 in.; height of ditto, 32 ft.; area of immersed section at load draft, 365 sq. ft.; load on safety valve in lbs. per square inch, 25; heating surface, 5,520 ft. Date of trial, April, 1859. Draft forward, 11 ft. 6 in.; ditto aft, 11 ft. 6 in.; maximum revolutions, 22.

Frames, 12 in. × $14\frac{1}{2}$ in. × 29 in. apart; depth of keel, 8 ft.; independent steam, fire, and bilge pumps, 1; masts, 2. Rig, brigantine.

Intended service—Coast of China.

DIMENSIONS OF STEAMER "INDIANOLA."

Built by Messrs. Haslan, Hollingsworth, and Co., of Wilmington, Del.

	Ft.	tenths.
Length on deck	151	0
,, at load line	149	0
Breadth of beam	26	0
Depth of hold	9	9
Depth of hold to spar deck	16	9
Length of engine space	40	0
	Tons.	
Hull	358·60	
Engine-room	74·10	
Register	358·60	

Kind of engine, direct acting; ditto boiler, drop return flue; diameter of cylinder, 28 in.; length of stroke, 2 ft. 4 in.; diameter of screw, 8 ft. 6 in.; length of screw, 3 ft. $8\frac{3}{8}$ in.; pitch of screw, 15 ft. 5 in.; number of blades of screw, 4; number of boilers, 1; length of ditto, 20 ft.; breadth of ditto, 9 ft. 6 in.; height of ditto, exclusive of steam-chests, 8 ft. 6 in.; number of furnaces, 2; breadth of ditto, 4 ft. 1 in.; length of fire bars, 6 ft.; number of flues above, 16; ditto below, 6; internal diameter of ditto above, $8\frac{1}{2}$ in.; ditto below, 2 of 21 in., 2 of 17 in., 2 of 16 in.; length of ditto above, 14 ft. 9 in.; ditto below, 9 ft.; diameter of chimney, 3 ft. 11 in.; height of ditto, 38 ft. 6 in.; area of immersed section at load draft, 160; load on safety valve in lbs. per sq. in., 27; heating surface, 1,077 ft. 26 in.; consumption of coals per hour, $\frac{3}{8}$ tons. Date of trial, March, 1859. Draft forward, 7 ft. $1\frac{1}{2}$ in.; ditto aft, 8 ft. $4\frac{1}{2}$ in.; maximum revolutions, 70; speed in knots with tide, 13; ditto against, $9\frac{1}{2}$; weight of engines, 64,000 lbs.; ditto boilers, with water, 62,000 lbs.

Frames—Shape, perpendicular, $3\frac{1}{2}$ in. × $\frac{3}{8}$ and $\frac{7}{8}$ in., and 18 by 20 in. apart; number of strake of plates from keel to gunwale, 10; thickness of plates, $\frac{5}{8}$ to $\frac{3}{8}$; number of bulkheads, 3; diameter of rivets, $\frac{3}{4}$ in.; distances apart, $2\frac{1}{8}$ in.; single riveted; keelsons, 8; depth of keel, 6 in.; independent steam, fire, and bilge pumps, 1; masts, 2. Rig, foretopsail schooner.

Intended service—New York to Havana.

Remarks—Has a wrought-iron waterway, 10 in. by $\frac{1}{2}$ in. Cargo ports on main deck, forward.

SHIP BUILDING AT DUMBARTON—FIRM OF ALEXANDER DENNY.

	Name of Ship.	Port of	Date.	Rigg.	Tons Register.	Length.	Breadth.	Depth.	Length of Engine Room.	Contents.	Total Tonnage.	Sailing, Screw, or Paddle.	Trade employed.	Machinery by	H.P.
1	*Livorno*	Liverpool	1850	Schooner	$349\frac{74}{100}$	157 5	24 5	15 4	36 2	$143\frac{59}{100}$	$493\frac{33}{100}$	Screw.	Liverpool and Genoa	J. & G. Thompson	95
2	*Genova*	Ditto	1850	Ditto	$349\frac{96}{100}$	163 5	24 5	15 4	42 5	170	$519\frac{96}{100}$	Ditto	Ditto	Ditto	114
3	*Nile*	Ditto	1850	Ditto	$347\frac{89}{100}$	164 0	25 3	15 0	42 5	$180\frac{65}{100}$	$528\frac{54}{100}$	Ditto	......	B. Hick and Sons	140
4	*Orontes*	Ditto	1851	Ditto	$538\frac{4}{100}$	188 0	26 8	17 0	42 5	$209\frac{55}{100}$	$747\frac{59}{100}$	Ditto	......	Ditto	...
5	*Pheobe*	Ditto	1851	Ditto	$397\frac{10}{100}$	172 6	25 0	15 6	42 6	189	$586\frac{10}{100}$	Ditto	......	Tulloch and Denny	...
6	*Menai*	Ditto	1851	Ditto	$140\frac{31}{100}$	165 0	19 6	9 6	37 0	$118\frac{4}{100}$	$258\frac{35}{100}$	Paddle	Liverpool and Menai Bridge	McNab and Clark	120
7	*Tourist*	St. Petersburg	1851	Ditto	$96\frac{20}{100}$	155 0	16 0	8 0	44 0	$59\frac{80}{100}$	156	Ditto	Plying on the Neva	Ditto	70
8	*Eagle*	Glasgow	1852	Sloop	$110\frac{31}{100}$	167 0	16 1	8 3	45 8	$66\frac{23}{100}$	$176\frac{54}{100}$	Ditto	Glasgow and Rothesay	Ditto	82
9	*Eva*	Greenock	1852	Ditto	$82\frac{95}{100}$	141 6	14 6	6 6	24 3	$25\frac{34}{100}$	$108\frac{29}{100}$	Ditto	Greenock and Garelochead	Matthew, Paul & Co.	...
10	*Queen Victoria*	Glasgow	1852	none	$67\frac{40}{100}$	130 0	14 6	6 4	30 1	$30\frac{43}{100}$	$97\frac{83}{100}$	Ditto	Lochlomond	Caird and Co.	33
11	*Melita*	Ditto	1852	Barque	$397\frac{10}{100}$	232 0	29 0	19 0	51 3	$305\frac{91}{100}$	703	Screw	Liverpool and Alexandria	McNabb and Clark	...
12	*Cleopatra*	Liverpool	1852	Ditto	$893\frac{48}{100}$	219 0	31 1	25 3	63 0	$558\frac{54}{100}$	$1452\frac{2}{100}$	Ditto	Plymouth and Melbourne	Tulloch and Denny	...
13	*Don Manuel*	Lisbon	1852	Schooner	$71\frac{34}{100}$	90 0	17 6	9 7	19 6	$38\frac{90}{100}$	$110\frac{24}{100}$	Ditto	......	Ditto	...
14	*Chanticleer*	Newcastle	1853	Ditto	$385\frac{62}{100}$	180 0	25 0	15 0	40 0	168	$553\frac{62}{100}$	Ditto	Newcastle and Rotterdam	Ditto	80
15	*Morecambes Queen*	Lancaster	1853	Ditto	$91\frac{71}{100}$	125 0	16 1	9 1	35 4	$59\frac{78}{100}$	$151\frac{49}{100}$	Paddle	Morecambe and Lancaster	Ditto	...
16	*William Denny*	Dumbarton	1853	Barque	$423\frac{88}{100}$	180 0	25 0	15 0	40 0	$172\frac{4}{100}$	$595\frac{92}{100}$	Screw	Australia	Ditto	100
17	*Oberon*	Liverpool	1854	Schooner	$66\frac{23}{100}$	89 0	19 0	7 6	18 0	$29\frac{12}{100}$	$95\frac{36}{100}$	Ditto	Ditto	Thos. Wingate & Co.	20
18	*Titania*	Ditto	1854	Ditto	$66\frac{23}{100}$	89 0	19 0	7 6	18 0	$29\frac{12}{100}$	$95\frac{36}{100}$	Ditto	Ditto	Ditto	20
19	*Baltic*	Hull	1854	Barque	$396\frac{62}{100}$	181 0	25 0	14 0	33 0	$130\frac{90}{100}$	$527\frac{52}{100}$	Ditto	Hull to Konigsberg	Tulloch and Denny	...
20	*Humber*	Ditto	1854	Ditto	$399\frac{62}{100}$	182 0	25 0	14 0	33 0	$130\frac{90}{100}$	$530\frac{52}{100}$	Ditto	Ditto	Ditto	...
21	*Excelsior*	Glasgow	1854	Schooner	$247\frac{12}{100}$	119 0	21 6	13 0	......	......	$247\frac{12}{100}$	Sailing	Glasgow and Buenos Ayres	......	...
22	*Hecla*	Liverpool	1854	Ditto	$567\frac{78}{100}$	206 0	25 0	16 0	37 0	$165\frac{37}{100}$	$733\frac{15}{100}$	Screw	......	Tulloch and Denny	...
23	*Metidjah*	Marseilles	1855	Barque	$517\frac{70}{100}$	214 0	26 0	15 9	41 0	$146\frac{21}{100}$	$663\frac{91}{100}$	Ditto	......	Ditto	...
24	*Sardinian*	Liverpool	1855	Ditto	$447\frac{56}{100}$	223 0	28 0	16 0	41 0	$224\frac{69}{100}$	$702\frac{15}{100}$	Ditto	Southampton & Barcelona	Ditto	120
25	*Victor Emmanuel*	Glasgow	1856	Schooner	$225\frac{14}{100}$	156 0	23 0	14 0	31 5	$105\frac{95}{100}$	$331\frac{9}{100}$	Ditto	Glasgow and Oporto	Blackwood & Gordon	70
26	*Eagle*	Ditto	1856	Ditto	$220\frac{33}{100}$	161 0	23 0	13 0	25 3	$103\frac{63}{100}$	$324\frac{01}{100}$	Ditto	Glasgow and Londonderry	Alexander Denny	70
27	*Athens*	Southampton	1856	Barque	$502\frac{68}{100}$	224 0	30 0	16 0	41 0	$236\frac{56}{100}$	$739\frac{24}{100}$	Ditto	Southampton and Gibraltar	Ditto	140
28	*Silistria*	Liverpool	1856	Ditto	$477\frac{46}{100}$	223 0	28 0	16 0	41 0	$224\frac{69}{100}$	$702\frac{15}{100}$	Ditto	Southampton & Barcelona	Tulloch and Denny	120
29	*Hakon Jarl*	Bergen	1857	Brig	$193\frac{89}{100}$	153 0	23 0	12 0	25 0	$91\frac{24}{100}$	$285\frac{13}{100}$	Ditto	Hamburgh and Bergen	Alexander Denny	60
30	*Cuba Packet*	Amsterdam	1857	Barque	$224\frac{71}{100}$	142 0	23 0	12 0	21 0	$47\frac{62}{104}$	$272\frac{33}{100}$	Ditto	Gibraltar & Cuba	Ditto	20
31	*Anna*	Rotterdam	1857	Schooner	$209\frac{81}{100}$	162 0	23 0	12 0	34 0	$98\frac{73}{100}$	$308\frac{54}{100}$	Ditto	Grangemouth & Rotterdam	Ditto	70
32	*Queen*	Aden	1857	none	$56\frac{54}{100}$ / $76\frac{16}{94}$	60 0 / 59 4	17 0 / 17 5	7 6 / 7 5	...... /	...... /	60 / 60	Sailing	Aden coaster	......	...
33	*Ruby*	Ditto	1857	none	60	60 0	17 0	7 6	......	......	60	Ditto	Ditto	......	...
34	*Star*	Ditto	1857	none	60	60 0	17 0	7 6	......	......	60	Ditto	Ditto	......	...
35	*Venus*	Ditto	1857	none	60	60 0	17 0	7 6	......	......	60	Ditto	Ditto	......	...
36	*Zara*	Cronstadt	1857	Schooner	$74\frac{83}{100}$	120 0	18 0	7 0	30 0	$43\frac{91}{100}$	$118\frac{77}{100}$	Paddle	St. Petersburg & Cronstadt	Alexander Denny	70
37	*El Apostle*	Cadiz	1858	Ditto	$267\frac{55}{100}$	162 0	23 0	13 0	25 3	$76\frac{44}{100}$	$343\frac{99}{100}$	Screw	Cadiz and Vigo	Ditto	70
38	*Harrier*	Glasgow	1858	Ditto	$287\frac{24}{100}$	172 0	23 0	13 0	25 3	$76\frac{38}{100}$	$363\frac{62}{100}$	Ditto	Glasgow and Liverpool	Ditto	70
39	*Framnaes*	Bergen	1858	Ditto	$135\frac{12}{100}$	133 0	21 0	11 0	24 0	$63\frac{56}{100}$	$198\frac{70}{100}$	Ditto	Bergen and Lasdeal	Ditto	40
40	*Fjalir*	Ditto	1858	Ditto	$135\frac{29}{100}$	133 0	21 0	11 0	24 0	$63\frac{67}{100}$	$198\frac{56}{100}$	Ditto	Ditto	Ditto	40

SHIPBUILDING ON THE CLYDE.

THE following are particulars, dimensions, &c., of vessels built by eminent Scottish houses for various parties during the last few years, and is given in continuation of those published in THE ARTIZAN for April last.

There are interspersed details, which although not relating to vessels built during the years 1857, 1858, and 1859; yet possess sufficient interest to justify their insertion here; and these particulars are given more with a view to place them on record, than attaining either order or chronological regularity in their publication.

THE GLASGOW AND GREENOCK SHIPPING COMPANY'S AUXILIARY IRON SCREW STEAMERS, "JAMES WATT" AND "HENRY BELL."

Dimensions.

	James Watt.	Hen. Bell.
Builders' measurement.	Ft. in.	Ft. in.
Length of keel and forerake	79 0	78 $8\frac{3}{8}$
Breadth of beam	17 $2\frac{3}{8}$	17 $2\frac{3}{8}$
Tonnage.	Tons.	Tons.
Total	$107\frac{89}{94}$	[illegible]
Engine-room	$25\frac{89}{94}$	$25\frac{87}{94}$
Register	$82\frac{6}{94}$	$81\frac{58}{94}$
Customs' measurement	Ft. ths.	Ft. ths.
Length (forepart of stem, to aft side of stern-post)	79 0	78 7
Breadth (extreme)	17 2	17 2
Depth of hold, amidships	7 1	7 0
Length of engine-room	16 5	16 5
Tonnage.	Tons.	Tons.
Gross	$68\frac{62}{100}$	$68\frac{62}{100}$
Engine-room	$21\frac{94}{100}$	$21\frac{96}{100}$
Register	$46\frac{73}{100}$	$46\frac{71}{100}$

Fitted with a pair of inverted cylinder (non-condensing engines of 25 H.P.; diameter of cylinders, 11 in. × 1 ft. 6 in. length of stroke; the screw has three blades, diameter 5 ft. × 11 ft. pitch; 1 tubular boiler (cylindrical), 6 ft. × by 8 ft. long; 60 tubes (brass), diameter, 2 in. × 5 ft. 10 in. long; 1 folding chimney, diameter, 1 ft. 3 in. × 15 ft.: steam-chest, diameter, 2 ft. 3 in. × 2 ft. 6 in. in depth; stem and keel, 5 in. × by 1 in.; screw-frame, inner post, 5 in. × $1\frac{1}{2}$ in.; outer ditto, 5 in. × $1\frac{1}{4}$ in.; frames, $2\frac{1}{2}$ in. × $2\frac{1}{2}$ in. × 5-16 in. and 1 ft. 6 in. apart; deck beams 3 in. × 3 in. × 5-16 in. and 3 ft. apart; knee-plates, 11 in. by $\frac{1}{4}$ in.; the plates of hull, 3-16 to 5-16 of an inch. Each vessel is fitted with a donkey engine; also a crane for cargo. The cabin is forward, machinery aft, the holds for cargo amidships; bunkers hold 5 tons of coal; steam pressure, 30 lbs. per square inch; consumes $1\frac{1}{2}$ cwt of coals per hour; average speed, 7 miles per hour; revolutions per minute (two bladed screw), 100; ditto (three bladed), 80; draft of water, with 100 tons of cargo, forward, 6 ft. and 6 ft. 6 in. aft; ditto, with 120 tons, ditto, forward, 6 ft. 6 in. and 7 ft. aft.

Plying between Glasgow and Greenock, &c., with cargo. *James Watt* launched in March; *Henry Bell*, ditto April 30th, 1859. No figure-head, galleries, bowsprit or mast; square-sterned and clinch-built vessels; one deck. Port of Glasgow. *James Watt*, Mr. John Campbell, master; *Henry Bell*, Mr. John Taylor, master.

CLYDE TRUSTEES' IRON PADDLE STEAMER "CLYDE."

Built by Messrs. James Henderson and Sons, shipbuilders, Renfrew; machinery by Messrs. Anthony and John Inglis, Whitehall foundry, Glasgow, 1851.

Lengthened in 1857.

Dimensions.

	1851.	1857.
Builder's measurement.	Ft. In.	Ft. In.
Length of keel and forerake	84 6	99 3
Breadth of beam	20 2	20 2
Ditto, including paddle-cases		37 6
Tonnage.	Tons.	Tons.
Total	$157\frac{[illegible]}{94}$	$189\frac{[illegible]}{94}$
Engine-room	$101\frac{[illegible]}{94}$	$105\frac{[illegible]}{94}$
Register	$55\frac{3}{9}$	$84\frac{[illegible]}{94}$
Act for foreign vessels.	Ft. ths.	Ft. ths.
Length on deck (inside stem and stern-post)	86 6	109 0
Breadth (inside frames)	19 5	19 5
Depth of hold (amidships)	8 5	8 5
Length of engine-room	47 9	47 9

Tonnage.	Tons.	Tons.
Total	$114\frac{37}{100}$	$132\frac{01}{100}$
Engine-room	$88\frac{88}{100}$	$88\frac{88}{100}$
Register	$25\frac{49}{100}$	$43\frac{13}{100}$

Fitted with a pair of (disconnecting) half-lever engines, of 78 nominal H.P.; diameter of cylinders, 34 × 4 ft. 6 in. length of stroke; diameter of paddle-wheels, extreme, 14 ft.; ditto effective, 13 ft. 6 in. (formerly 15 ft. 0 in.; ditto, 14 ft. 6 in.); 15 floats, 6 ft. 6 in. × 1 ft. 7 in.; two return flue boilers, length, 19 ft. 6 in.; diameter, 7 ft. 7 in.; steam chests, length above 7 ft. 3 in.; ditto below, 8 ft.; breadth above, 2 ft. 6 in.; ditto below, 4 ft. 6 in.; depth, 4 ft.; return flues, lower, 2 ft. × 2 ft. 9 in.; ditto, upper, 1 ft. $11\frac{1}{4}$ in. × 2 ft. 7 in.; four furnaces, length, 6 ft. 6 in.; breadth, 3 ft.; depth, 3 ft. 5 in.; one folding chimney, diameter, 3 ft. × 22 ft. $1\frac{1}{2}$ in. is fitted under the bars at the bridge with channel doors to regulate the draught. Contents of coal bunkers, 10 tons; consumes 7·9 cwt. per hour; steam pressure per sq. in., 10 lbs.; draft of water, forward, 5 ft. 9 in. and 6 ft. 6 in. aft.; revolutions per minute, running light, 36; ditto, with an average train of 30 punts, 12 tons (of gravel, &c., from the bed of the river); total, 360 tons; 22 revolutions; is strongly built, and has three bulk-heads.

Launched half-past 2 p.m., October 15th, 1851. Relaunched after being lengthened by the builders, February 26th, 1857. Began to ply February 28th.

DESCRIPTION.

No figure-head, galleries, bowsprit, mast, or rigging; round sterned and clinch-built vessel; one deck.

Port of Glasgow.—Commander, Mr. John Robertson (late of the *Tug*).

CLYDE AND MAURITIUS IRON CLIPPER SAILING SHIP "TWILIGHT."

Built by Messrs. Robert Napier and Sons, Glasgow, 1855.

Dimensions.

Builders' measurement.	Ft.	in.
Length of keel and forerake ...	160	0
Breadth of beam	30	0
	Tons.	
Tonnage	$679\frac{72}{94}$	
Custom's measurement.	Ft.	tenths.
Length, fore part of stem under the bowsprit to after part of stern-post at head ...	167	3
Breadth (extreme)	30	0
Depth of hold (at midships)...	20	0
	Tons.	
Tonnage	$609\frac{85}{100}$	

Classed 12 years, A 1, at Lloyds'; 3 bulk heads; wire rigging, fitted with Cunningham's Patent Reefing Apparatus for the fore and main top sails; carries 790 tons of cargo, on 17 ft. forward × 17 ft. 6 in. aft; greatest speed, 11 knots.

DESCRIPTION.

A demi-female figure-head; round-sterned and clinch-built vessel; 2 decks (with forecastle deck); 3 masts; standing bowsprit; no galleries; owners, Messrs. Robert Hastie and Co.

Port of Glasgow.—Commander, Mr. Daniel M'Callum, late of the *Three Bells.*

THE BRITISH AND NORTH AMERICAN ROYAL MAIL STEAM NAVIGATION COMPANY'S IRON PADDLE-WHEEL STEAM-VESSEL "PERSIA."

Built and fitted with machinery by Messrs. Robert Napier and Sons, Glasgow, 1855.

Dimensions.

Builders' measurement.	Ft.	in.
Length of keel and forerake ...	360	0
Breadth of beam	45	$3\frac{1}{2}$
Tonnage.	Tons.	
Total	$3628\frac{12}{94}$	
Engine-room	$1396\frac{11}{94}$	
Register	$2230\frac{1}{94}$	
Custom's measurement.	Ft.	tenths.
Length, fore part of stem to after part of stern post at head	376	0
Breadth (extreme)	45	3
Depth of hold at midships	30	0
Length of engine-room	107	2
Tonnage.	Tons.	
Hull	$3099\frac{70}{100}$	
Deck houses (9 in number) ...	$200\frac{63}{100}$	
Total	$3300\frac{33}{100}$	
Engine-room	$1221\frac{12}{100}$	
Register	$2079\frac{21}{100}$	

Fitted with a pair of side lever engines of 824 nominal H.P.; diameter of cylinders, $100\frac{1}{2}$ in. × 10 ft. length of stroke; paddle-wheels: diameter, extreme, 39 ft. 7 in.; ditto effective, 38 ft. 6 in.; 28 floats, 10 ft. 8 in. × 2 ft. 1 in.; 6 tubular boilers; 40 furnaces; 2 chimneys. The hull is very strongly built; has diagonal frames forward; the model is considered to be of beautiful proportions, as the regularity of the voyages to and from Liverpool to New York (3,048 miles) abundantly testify. Has a deck-house, extending from bow to stern, forming a promenade in good weather for the passengers. The cabins are fitted up in the first style of art. The average draft of water is 21 ft. 6 in.

Had this vessel been fitted with the feathering-wheels the voyage might have been accomplished in 24 hours less time.

Launched July 3rd.

DESCRIPTION.

A demi-female figure head; clipper bow; round-sterned and clinch-built vessel; standing bowsprit; 2 masts; brig-rigged; 3 decks; no galleries; official number of ship, 11,523.

Port of Glasgow.—Commander, Charles Henry Evans-Judkins, Esq., late of the *Arabia.*

THE ST. ROLLOX SHIPPING COMPANY'S IRON SCREW STEAM-VESSEL "BRIGAND."

Built by and fitted with machinery by Messrs. Smith and Rodger, Engineers and Iron Shipbuilders, Glasgow, 1848; lengthened by Messrs. James Henderson and Sons, Engineers and Iron Shipbuilders, Renfrew, 1857.

Dimensions.		Ft.	tenths.
Length on deck (inside stem and stern post)		167	3
Breadth (at 2-5ths of midships depth)		22	2
Depth of hold (at midships)...		13	5
Length of engine-room		36	2
Tonnage.		Tons.	
Total		$413\frac{67}{100}$	
Engine-room	$117\frac{41}{100}$	$125\frac{99}{100}$	
Shaft-space	$8\frac{58}{100}$		
Register		$287\frac{68}{100}$	

Fitted with a pair of geared steeple engines (on the four piston-rod patent principle of Mr. David Napier), of 50 nominal H.P.; diameter of cylinders, 30 in. × 2 ft. 6 in. length of stroke; screw diameter, 10 ft. × 10 ft. pitch; three blades, geared 2 to 1; 1 tubular boiler; capacity of coal bunkers, 120 tons; steam pressure per square inch, 17 lbs.; average draft of water, forward, 9 ft. × 12 ft. aft.; carries 442 tons of cargo.

Plying between Glasgow and Bristol (421 miles), returning from thence, calling at Swansea, Belfast, and Greenock.

THE TIMBER-BUILT WHALE-FISHING SCREW STEAM TOWING-VESSEL "JACKALL."

Built by Messrs. Barclay, Curle and Co., Shipbuilders, Glasgow; machinery by Messrs. Anthony and John Inglis, Engineers, Whitehall Works, Glasgow.

Dimensions.	Ft.	tenths.
Length	54	3
Breadth	14	4
Depth	8	2
Tonnage.	Tons.	
Total	$33\frac{41}{100}$	
Engine-room	$24\frac{55}{100}$	
Register	$8\frac{86}{100}$	

Fitted with a pair of inverted cylinder engines, of 12 nominal H.P.; diameter of cylinders, 16 in. × 1 ft. 8 in. length of stroke; the screw has two blades, diameter, 6 ft. × pitch 12 ft.; length on axis, 1 ft. 3 in.; one tubular boiler, length, 7 ft. 7 in.; breadth, 6 ft. 7 in.; depth, 7 ft.; two furnaces, 4 ft. 6 in. × 2 ft. $6\frac{1}{2}$ in.; 85 tubes, diameter, $2\frac{3}{4}$ in. × 5 ft.; one chimney, diameter, 2 ft. 3 in. Date of trial trip, April 27, 1857. The speed of the vessel was $8\frac{1}{2}$ knots an hour; the engines averaging 85 revolutions per minute; steam pressure, 15 lbs. per square inch; weight of engines, boiler, and water, $18\frac{1}{2}$ tons. Employed at Davis' Straits.

DESCRIPTION.

A quadruped figure-head; no galleries; one deck; square-sterned and carvel-built vessel; two masts; schooner-rigged; standing bowsprit; classed 9 years A 1 at Lloyd's. Owners, Messrs. Hutchinson.

Commander, D. Leith.

Port of Peterhead—Launched April 14th, 1847.

THE SCHOONER "MARY ANN."

Built by Messrs. Barclay, Curle and Co., Shipbuilders, Stobcross, Glasgow, 1859.

Dimensions.	Ft.	tenths.
Length	64	2
Breadth	18	3
Depth	7	9
Tonnage	$56\frac{41}{100}$ tons.	

For the coasting trade; classed 8 years A 1 at Lloyd's; launched February 19th.

DESCRIPTION.

No figure-head or galleries; round-sterned and carvil-built vessel; running bowsprit; two masts; one deck; Port of Campbeltown.

THE GLASGOW AND LISBON SCREW STEAM-PACKET COMPANY'S IRON STEAM-VESSELS, "DOM PEDRO" AND "DOM AFFONSO."

Built by Messrs. Robert Steele and Co., Shipbuilders, Greenock; machinery by Messrs. Randolph, Elder and Co., Engineers, Glasgow, 1856.

Dimensions.	*Dom Pedro.*			*Dom Affonso.*	
	Ft.	tenths.		Ft.	tenths.
Length	159	7	......	161	9
Breadth	20	1	......	20	5
Depth	12	5	......	12	4
Tonnage.	Tons.			Tons.	
Hull	$258\frac{59}{100}$		......	$247\frac{84}{100}$	
Break	$40\frac{34}{100}$		......	$42\frac{29}{100}$	
Total	$299\frac{92}{100}$		......	$290\frac{13}{100}$	
Engine-room ..	$55\frac{65}{100}$		......	$55\frac{77}{100}$	
Register	$244\frac{27}{100}$		......	$240\frac{22}{100}$	

Fitted with a pair of Messrs. Randolph, Elder and Co.'s patent engines, of 90 H.P. collectively; diameter of condensing cylinders, 30 in.; non-condensing ditto 19 in. × 1 ft. 6 in. The screw has two blades; diameter, 11 ft. 6 in. × 14 ft. pitch; fitted with Elder's patent spiral flue boiler; consumes 17 cwt. of coals in four hours; steam pressure, 15 lbs.; revolutions per minute, 58; average draft of water, 11 ft. forward × 12 ft. aft.; the bunkers hold 80 tons of coals, sufficient for fourteen days' consumption; can carry 320 tons of cargo; average speed, $7\frac{1}{2}$ knots an hour; two water-tanks, capable of carrying 1,200 gallons of water; has a donkey-engine; diameter of cylinder, $6\frac{1}{2}$ in. × 6 in. length of stroke, besides three other pumps; carries three boats; the cabins accommodate 16 passengers. They are each manned by a crew of 16 persons, plying from Glasgow to Lisbon, Gibraltar, Genoa, Leghorn, Messina, and Palermo; classed 9 years A 1; 4 bulk-heads.

DESCRIPTION.

A demi-man figure-head; round-sterned and clinch-built vessel; standing bowsprit; three masts (pole); schooner (wire) rigged; $1\frac{1}{4}$ decks. Port of Glasgow.

Dom Pedro.—Commander, Mr. Edward Scott.

In February, 1857, the *Dom Pedro* went out as far lat. 50 N. 11 W. lon., in search of the abandoned ship *Arthur*, of Glasgow (of $987\frac{24}{100}$ tons). Length, 155 ft. 1 tenth; breadth, 30 ft. 2 tenths; depth, 22 ft. 7 tenths; and brought the vessel in safety to Port Glasgow, being one of the boldest enterprising undertakings in maritime affairs.

THE GLASGOW, WATERFORD, AND CORK SCREW STEAM-SHIPPING COMPANY'S IRON STEAM-VESSEL "VIVANDIERRE."

Built by Messrs. William Simons and Co., Shipbuilders, Whiteinch, Glasgow; machinery by Messrs. Anthony and John Inglis, Engineers, Whitehall Works, Glasgow, 1856.

[Act, 1855.]	Ft.	tenths.
Length on deck	151	$9\frac{1}{2}$
Breadth at midships	21	0
Depth of hold at ditto	12	0
Length of engine-apartments .	24	8
Tonnage.	Tons.	
Hull	$227\frac{24}{100}$	
One house amidships, for cabin, &c.	$18\frac{08}{100}$	
Total	$245\frac{32}{100}$	
Contents of engine-apartments	$78\frac{50}{100}$	
Register	$166\frac{32}{100}$	

[Builders' or Old Measurement.]

	Feet.
Length of keel and fore rake.	147
Beam	21
Tonnage.	Tons.
Total	$315\frac{10}{94}$
Engine-apartments	$57\frac{46}{94}$
Register	$257\frac{58}{94}$

Fitted with a pair of inverted cylinder (trunk) engines, of 52 nominal H.P.; diameter of cylinders, 30 in. × 2 ft. 3 in. The screw has two blades, and the diameter 7 ft. 6 in. × 16 ft. 9 in. pitch; length on axis, 2 ft. 1 in.; one tubular boiler, length, 8 ft. 8 in.; breadth, 11 ft.; depth, 11 ft.; 176 tubes, diameter, $2\frac{7}{8}$ in. × 6 ft. 6 in.; there are three furnaces, length, 5 ft. 6 in. × 3 ft. 3 in.; one chimney, diameter, 3 ft. 3 in.; average draft of water, 10 ft. fore and aft.; consumes 6·9 cwt. of coals per hour; heating surface, 997·328 ft.; revolutions per minute, 80; speed with tide at trial, June 14th, 1856, 10·1 knots; ditto, against, 9·5 knots; carries 250 tons of cargo. The accommodation for passengers are 13 cabin and 44 deck; total, 57 in winter and 74 in summer (Board of Trade Act). Average passages:—Greenock to Cork (423 miles), 38 hours; Cork to Waterford (90 miles), 8 hours. Launched May 22nd.

DESCRIPTION.

A demi-woman figure-head; square-sterned and clinch-built vessel; no galleries; standing bowsprit; two masts; schooner-rigged; one deck; official number of vessel, 15,466; class 12 years A 1; 4 bulk-heads.

Port of Glasgow—Commander, Mr. Charles Calder (late of the *Killarney*).

THE TUSCAN GOVERNMENT IRON PADDLE-WHEEL STEAM-VESSEL "SAINT VITTORIO."

Dimensions.	Ft.	tenths.
Length on deck	83	3
Breadth	16	6
Depth	8	2
Length of engine-room	30	0
Tonnage.	Tons.	
Total	$81\frac{74}{100}$	
Contents of engine-room	$44\frac{19}{100}$	
Register	$37\frac{55}{100}$	

Fitted with one-half lever-engine, of 30 nominal H.P.; diameter of cylinders, 30 in. × 3 ft. 6 in. length of stroke; diameter of paddle-wheels, 13 ft.; 13 floats, 5 ft. 6 in. × 1 ft. 5 in.; one tubular boiler, length, 9 ft. 1 in.; breadth, 7 ft. 8 in.; depth, 7 ft. 7 in.; 90 tubes, diameter 3 in.; 2 furnaces, 5 ft. 6 in. × 3 ft. 1 in.; 1 chimney, diameter 2 ft. 6 in. On the trial trip, November 1st, 1853, was satisfactory to all concerned.

DESCRIPTION.

A bust-man figure-head; no galleries; square-sterned and clinch-built vessel; one deck; one mast; sloop-rigged; standing bowsprit.

Port of Leghorn—Owner, The Grand Duke of Tuscany.

THE CLYDE SHIPPING COMPANY'S NEW IRON SAILING SLOOPS "RENFREW" AND "DUNGLASS."

Built by Messrs. William Simons and Co., Shipbuilders, Whiteinch, Glasgow, 1857.

Dimensions.	Ft.	tenths.
Length	70	2
Breadth	17	6
Depth	6	$7\frac{1}{2}$
Tonnage.	Tons.	
Register (British or Builders' measurement)	$99\frac{71}{94}$	
Ditto (American) U.S.	$75\frac{75}{95}$	
Ditto (British, Act 1836)	$67\frac{780}{3500}$	
Ditto (Ditto, Act for foreign vessels)	$60\frac{99}{130}$	
Ditto (Ditto, present Act)	$53\frac{70}{100}$	

These vessels are fitted with jib cranes for loading and discharging cargo, are strongly built, employed in coasting on the Clyde, &c., carrying 100 tons of cargo generally; when deeply loaded 120 tons. *Renfrew* launched April 25th; *Dunglass* launched May 30th.

DESCRIPTION.

No figure-head, bowsprit, masts, or galleries; one deck; round-sterned and clinch-built vessels.

Port of Glasgow.

"JAMES CAMPBELL," BARQUE, OF GREENOCK,

Built at Dumbarton, 1842.

Dimensions.	Ft.	tenths.
Length on deck	100	7
Breadth	23	1
Depth	16	6
Tonnage	$325\frac{09}{100}$ tons.	

A full man figure-head; square-sterned and carvil-built vessel.

THE OLDEST STEAMER IN THE WORLD.

THE CLYDE SHIPPING COMPANY'S TIMBER PADDLE-WHEEL STEAM-VESSEL "INDUSTRY."

Built by Messrs. John and William Fyfe, Shipbuilders, Fairlie, 1814; machinery by Messrs. Caird and Co., Engineers, Greenock, 1829.

[Builders' or Customs' old Act.]	Ft.	in.
Length aloft	68	4
Keel and fore rake	67	6
Breadth of beam	16	6
Ditto, including paddle-boxes	26	11
Tonnage.	Tons.	
Total	$83\frac{36}{94}$	
Engine-room	$28\frac{91}{94}$	
Register	$54\frac{39}{94}$	
[Customs' Act, 1836.]	Ft.	tenths.
Length on deck	66	9
Breadth	14	7
Depth	8	1
Length of quarter-deck	10	2
Breadth	13	0
Depth	1	3
Length of engine-room	20	0
Tonnage.	Tons.	
Hull	$77\frac{12}{100}$	
Quarter-deck	$1\frac{80}{100}$	
Total	$78\frac{92}{100}$	
Engine-room	$26\frac{60}{100}$	
Register	$52\frac{32}{100}$	

One side lever-engine (on the second motion), of 15 nominal H.P.; diameter of cylinder, 23 in. × 2 ft. 8 in. length of stroke; diameter of paddle-wheels, extreme, 11 ft.; ditto, effective, 10 ft. 7 in.; 10 floats, 3 ft. × 1 ft. 9 in.; one flue boiler, length, 5 ft. 6 in.; breadth, 14 ft.; depth, 5 ft. 9 in.; two furnaces. Carries 70 tons of cargo. The builders' certificate is dated 14th of April, 1814. Launched May, 1814. Plying between Glasgow, Port Glasgow, and Greenock with goods, &c., &c.

DESCRIPTION.

No figure-head; galleries; bowsprit; mast; square-sterned and carvil-built vessel.

Port of Glasgow—Commander, Mr. John Brodie.

THE BARQUE "MARGARETTA."

Built by Messrs. Robert Steele and Co., Greenock, 1858.

Dimensions.	Ft.	tenths.
Length	122	8
Breadth	22	8
Depth	12	7
Tonnage.	Tons.	
Hull	$208\frac{81}{100}$	
Break	$4\frac{77}{100}$	
Register	$213\frac{58}{100}$	
Ditto (old measurement)	$294\frac{19}{94}$	

Port of Greenock—For the Newfoundland trade. Classed 13 years A 1. Owners, Messrs. Baine and Johnstone. Launched November 8th. Capt. Scott. April 30th, 1858, on the return voyage from Bristol to the Clyde, came into collision with the barque *James Campbell*, outward-bound from the Clyde to Trinidad. Both soon after foundered, and was lost between Wicklow and Houth.

DESCRIPTION.

A full male figure-head; clipper-bow; standing bowsprit; 3 masts; schooner-rigged; 1 deck; square-sterned and clinch-built vessel.

Port of Glasgow.—Commander, Mr. Samuel Slowley.

The *Brigand* was lately in the Mediterranean and Liverpool trade.

* For further particulars of *Brigand*, see The Artizan for August, 1848.

THE ST. ROLLOX SHIPPING COMPANY'S IRON SCREW STEAM-VESSEL "OSCAR."

Built by Messrs. William Denny and Brothers, iron shipbuilders, Dumbarton, 1850; machinery by Messrs. Coates and Young, Belfast.

Dimensions, Act 1836.	Ft.	tenths.
Length on deck (inside stem and stern-post)	156	4
Breadth (at $\frac{2}{3}$ of midship depth)	22	6
Depth of hold (at midships)	13	1
Length of engine-room	34	9
Tonnage.	Tons.	
Total	$361\frac{87}{100}$	
Engine-room	$125\frac{75}{100}$	
Register	$236\frac{12}{100}$	
Act, 1855.	Ft.	tenths.
Length, fore-part of clipper stem, under the bowsprit, to aft side of stern-post	159	6
Breadth (extreme)	23	2
Tonnage.	Tons.	
Hull	$310\frac{30}{100}$	
Quarter-deck	$20\frac{16}{100}$	
Total	$330\frac{46}{100}$	
Engine-room	$132\frac{59}{100}$	
Register	$197\frac{87}{100}$	

Fitted with a pair of geared beam-engines of 70 nominal H.P.; diameter of cylinders, 34 in. × 3 ft. length of stroke; screw, diameter, 10 ft. × 10 ft. pitch; 3 blades; 1 tubular boiler—length, 9 ft. 8 in; breadth, 14 ft. 9 in.; depth, 11 ft. 10 in.; steam-chest—length, 4 ft.; breadth, 3 ft. 9 in.; depth, 4 ft. 6 in.; 4 furnaces—length, 5 ft. 4 in.; breadth, 3 ft.; depth, 3 ft. 6 in.; 284 tubes—diameter, 3 in. × 7 ft. 6 in. in length; bunkers hold 44 tons of coals; steam pressure per sq. in., 13 lbs.; consumes 10 cwt. of coals per hour; engines average 30 revolutions per minute; draft of water, forward, 8 ft. 6 in. × 11 ft. aft; average cargo, 280 tons; can carry 547 tons.

Glasgow to Belfast (average passage)	12 hours.	
Belfast to Bristol	38 „	
Bristol to Swansea	$6\frac{1}{2}$ „	

Carries 18 cabin and 58 deck passengers; total, 76 in winter and 104 in summer (per Board of Trade Act). Formerly plied between Belfast and London.

DESCRIPTION.

A full male figure-head; no galleries; square-sterned and clinch-built vessel; $1\frac{1}{4}$ decks; standing bowsprit; 3 masts; schooner-rigged; official number of ship, 598.

Port of Glasgow.—Commander, Mr. William Fry.

PADDLE STEAMER "LONDON."

Built by Mr. John Wood, Port Glasgow, 1837. Registered 17th May, 1853.

	Tons.	Tons.
Register	$405\frac{86}{100}$	$391\frac{40}{94}$
	Ft.	tenths.
Length	167	0
Breadth	25	7
Depth	18	0
Length of engine-room	56	2
	Tons.	
Tonnage of ditto	$281\frac{3}{100}$	

Full female figure-head; sham galleries; square stern; carvil built; standing bowsprit; three masts; schooner-rigged; William Watts, commander; station, Dundee and London; owners, Dundee, Perth, and London Steam Navigation Company: transferred to Melbourne, 21st December, 1853.

DIMENSIONS OF "WASP."

Built by Messrs. Blackwood and Gordon; engines of 64 nominal H.P., by Blackwood and Gordan.

	Ft.	tenths.
Length on deck	131	9
Breadth of beam	19	$1\frac{1}{2}$
Depth of hold at ditto	8	5
Tonnage.	Tons.	
Hull	$130\frac{01}{100}$	
Engine-room	$58\frac{10}{1001}$	
Register, N.M.	$91\frac{91}{100}$	

Kind of engines, steeple engines; ditto, boilers, upright tubular; diameter of cylinders, 2 ft. 9 in.; length of stroke, 3ft. 6 in.; diameter of paddle-wheels over boards (or of screw), 14 ft. $7\frac{1}{2}$ in.; length of boards or screw, 6 ft.; depth of ditto (or pitch of screw), 1 ft. 4 in.; number of ditto (or blades of screw), 15; number of boilers, 1 upright tubular; diameter, 10 ft. 6 in.; height of ditto, exclusive of steam-chest, 12 ft. 3 in.; number of furnaces, 4; breadth of ditto, 2 ft.; length of fire-bars' 6 ft. 4 in.; number of tubes, 248, at $3\frac{3}{4}$ in.; internal diameter of ditto, 68 at 2 in.; length of ditto, 4; diameter of chimney, 2 ft. 11 in.; height of ditto, 18 ft.: load on safety-valve in lbs. per square inch, 20 lbs.; the surface in tubes, 1,002 ft.; furnaces, 347 ft. 5 in.; total 1,349 ft. 5 in.

W. F. Brock.

INSTITUTION OF CIVIL ENGINEERS.

May 3, 1859.

George P. Bidder, Esq., Vice-President, in the Chair.

The Paper read was On the Tyne Docks at South Shields, and on the Mode adopted for Shipping Coals, by Mr. T. E. Harrison, M. Inst. C.E..

These docks had been constructed on the banks of the River Tyne, at the upper end of South Shields, on a large area called Jarrow Slake, which was covered with water at spring-tides to a depth of from 5 ft. to 8 ft. The area so covered amounted to about 350 acres, and of this quantity 179 acres were now enclosed. The area of water in the dock, as executed, was 50 acres, the depth of water being 24 ft. 6 in. at an average spring-tide. The entrance basin was 9½ acres in extent, with a depth of water of 25 ft., for a width of 200 ft. in the centre of the channel, gradually shoaling to the sides. One entrance had a width of 80 ft., and there was a lock 300 ft. in length and 100 ft. in width, with gates 60 ft. in width; the cills in each case were laid 24 ft. 6 in. below high water of average spring-tides—such spring-tides having a lift of 14 ft. 6 in.

The total quantity of excavation in the docks was 1,783,452 cubic yards, and in forming the standage ground, 281,305 cubic yards. The total quantity of masonry of all descriptions was 2,900,000 cubic ft. The cost, up to the date of the opening for public traffic, was £440,476. This sum included all the standage and railway approaches, the shipping jetties, the purchase of land, and all the dockworks, but it excluded Parliamentary and other charges, not engineering. The works were under the immediate superintendence of Mr. Robert Hodgson, as resident engineer; and the contract for their execution was let to Mr. James Gow.

The first point of engineering interest was the nature of the foundations. A series of careful borings showed, that though there was, in places, a strong, stony clay, resting on the coal measures, yet that this clay was very partial, dipping suddenly away. Within a few yards of the clay-bed borings were made to a depth, in some places, of 70 ft. and upwards, through the mud, or slake deposit, without getting a bottom; showing that not only the clay, but the coal measures, were gone. The original level of the ground was ascertained to be 10 ft. below the lowest ebb of a spring-tide at the present time, confirming the opinion that a general depression of the East coast had taken place.

The first operation in the construction of the works was to form a culvert, 5 ft. in diameter, round the head of the dock area, to receive and carry off the upland waters. Dams were then formed of the materials from the excavations, consisting partly of clay and partly of slake, and after their completion, the water was run off by sluices. Shortly after the first course of masonry of the foundations was laid for the north, or 60 ft. lock, the floor was observed to rise very regularly about 3 in. in the centre. A bore-hole was then put down, when a strong feeder of water came away. The hole was, therefore, kept open during the progress of the works, and similar holes were made in other places. The flooring of the lock went back, partially, after the hole had been open several days: and it was brought nearly to its original level by being weighted with stone.

In building a quay-wall opposite the Jarrow Chemical Works, it was found that the slake would not bear the weight of the bank behind it, unless at a slope of one to five. As so flat a slope was inadmissible, the plan adopted for overcoming the difficulty was, by weighting the top with gravel—by which the toe of the slope was forced out. It was not until 150,000 tons of gravel had been deposited, that the whole came to a state of rest. The slope was at present 1¼ to 1. It was pitched with stone, and rested at the bottom on a strong row of piles.

With a view of testing practically the sustaining power of the mud or slake, a bed of concrete, 10 ft. square, was gradually loaded with iron, to the extent of 7 cwt. per superficial foot, without any settlement taking place; but as soon as that weight was exceeded, the whole began to sink. The foundations of the timber-jetties, for the shipment of coals, were therefore laid on a widespread base of concrete, with timber cill pieces; care being taken not to exceed a weight of 5 cwt. per superficial foot. It was satisfactory to be able to state that there had not been the slightest appearance of settlement.

Immediately below the entrance to the tidal basin, there was a canch of hard clay running out into the river. This had been entirely removed by dredging, and the flood and ebb tide now took their course as nearly as possible over the same channel, guided by the concave River Wall. The latter was entirely constructed of creosoted timber by means of one of Nasmyth's steam pile-engines. A description was then given of this machine, which was so arranged that it formed its own roadway throughout; and it was remarked, that where there was a large amount of straightforward piling, or in cases of difficult driving, this machine was without an equal.

The dock gates were generally on the same plan as those of the Victoria (London) Docks. The only difference was that the Tyne dock-gates were curved both on plan and in section, the pivot of the heel-post being raised 3 ft. 6 in. above the level of the cill. There was thus less danger of anything lodging behind the heel-post, and the invert of the lock was carried right through from the end of the pointing cill. It involved, however, some large and rather intricate masonry, and necessitated great accuracy in fitting the doubly-curved wood-cills to the doubly-curved masonry; but this had been successfully accomplished, and the cills were perfectly tight. One of the advantages in the use of wrought-iron for dock-gates was that, from their flotation, the weight on the rollers might be adjusted at pleasure. The sluices were all made to work with brass against brass. The dock-gates and sluices were arranged to be worked either by hand or by hydraulic power, the machinery for the purpose having been furnished by Sir W. G. Armstrong and Co.

The primary object of the construction of the Tyne Docks was to provide accommodation for the shipment of the large quantity of coals brought to South Shields, from the coal-fields of Durham and Northumberland, by the extensive system of railways belonging to the North Eastern Railway Company. The coal trade of the Northern coal-fields had been gradually increasing for many years past; and in 1858, the quantity shipped at South Shields amounted to 1,203,524 tons, although the facilities were so limited that it was necessary to work night and day throughout the whole year. This was now wholly shipped at the Tyne Docks, and the work was generally done in fifteen hours.

A brief account was then given of the different methods of shipping coals used at the Northern coal-ports during the last forty-seven years. The system of "keels" was first described; and it was stated that it still existed, to a limited extent, both on the River Wear and on the River Tyne, in the case of those collieries not having direct railway communication to a place of shipment. Where the vessels could reach the shipping places, as at the Wall's End Colliery, the mode of shipment was by spouts, in general principle the same as those adopted at the Tyne Docks; but without, for a long time, any arrangement for allowing for the difference in the level of the tide and in the size of the vessel. The first innovation on the "spout" system took place in 1812, when a coal-drop was erected at Pelaw Main Spout, on the River Tyne, by Mr. B. Thompson, further improved by him in 1813, and since generally followed, with various modifications. The principle of all these drops was, that the loaded waggon in its descent raised a counterbalance weight; and when the coals were let out of the waggon, the counterbalance weight brought the waggon back to its previous position. The system of tubs fitted into "keels," in order to avoid the breakage of the coal, was then alluded to, and the machinery by which they were transferred to the vessel was briefly described.

It was stated, that after mature deliberation, and careful examination of all the different plans, it was decided to adopt in the Tyne Docks the system of shipping by spouts. The angle of inclination of the spouts was 50°, that having been found by experiment to be the angle at which coals would slide on smooth iron plates, without rolling. In order to allow for the varying level of the ship's deck, which it was shown might amount, under certain circumstances, to 20 ft., arrangements were made to deliver the coals at four different levels. The coals were directed into any one of four divisions, by the opening or shutting of trap doors, turning on hinges, and well balanced, so as to be easily moved. The spout was also raised or lowered in guides, and was operated by winches, the men standing on the level at which they worked when shipping coals. Traps were also provided for regulating the descent of the coals into the ship. In some cases, the spouts were made to slide in a frame turning on a pivot, the object being to give a greater range into the ship's hold, particularly with screw colliers, and thus avoid the necessity of moving the ship. In practice, the plan was to keep the spout nearly full, merely letting the coals slide sufficiently down to allow of the next waggon being teamed; so that, although in the first filling of the spout, or on altering the level of the spout, the coal had a few feet to fall, yet this only applied to a small quantity of coal. Afterwards the whole mass slowly descended, and no further breakage took place.

Two jetties, on which there were twenty shipping places, were already at work. The shipping places were 100 ft. apart from centre to centre, and were so arranged that the vessels overlapped each other. Arrangements were made so that the number of shipping places could be increased to fifty, as the trade required. In laying out the ground, the saving of manual labour had been a primary consideration, and gravity had been called into operation to the utmost possible extent. The sidings into which the locomotive engines brought the waggons were on an inclination of 1 in 132. From these sidings the waggons were sorted, by gravity, into one or other of fourteen additional sidings, also on an inclination of 1 in 132, but at the curves and switches of 1 in 66. This sorting was effected by one man and one boy (who attended to the switches) for each jetty. When the waggons were wanted for shipment, they were brought out of the sidings, and descended by gravity, converging to one point, where there was a weighing machine; when passing over this machine at a rate not exceeding two miles an hour, the weights were easily taken. The lines then branched out again to the different spouts, the waggons being directed into their proper roads by switches, the working of which was attended to by one boy. There was a considerable amount of standage provided for each spout, and the length of single line of rails for each jetty was six miles. The standage was on inclinations varying fram 1 in 32 to 1 in 100. Where the waggons descended from this standage to the spouts, the inclination varied from 1 in 20 to 1 in 87. The empty waggons were returned along two lines, one on each side of the jetty, having an inclination of 1 in 100. The impetus of the loaded waggons in descending carried them up this gradient, to or beyond the places where they were to be emptied, and when emptied gravity took them away. Experience had shown that twelve chaldron waggons, or six 8-ton waggons, might be taken down at a time. They were all run past the hopper, then dropped back by gravity, and were emptied three or two at a time, as they passed over the spout, without being uncoupled. Great expedition resulted from this arrangement, and on the day of the opening, a screw-steamer entered the docks, received on board 420 tons of coal in fifty-five minutes, and immediately went to sea.

In order to ship the quantity of coals now transferred to, and being shipped in the Tyne Docks, there were employed last year at South Shields thirty-four horses and four pilot engines, and the work was carried on throughout the whole twenty-four hours. Under the present arrangement, not a single horse was employed, and only two pilot engines, and the work was done generally in fifteen hours. At present there was rather a deficiency of standage for light waggons, but this was in course of remedy, and when completed no pilot engine would be necessary. The cost of labour for carrying the coal along the jetty, a distance of 1,050 yards for the shipment, and for returning the empty waggons to the point where the engine took them up, was about seven-sixteenths of a penny per ton.

May 24, 1859.

Joseph Locke, Esq., M.P., President, in the Chair.

The Paper read was, On the Manufacture of Malleable Iron and Steel, by Mr. Henry Bessemer. Attention was directed, in the early part of the Paper, to the ordinary mode of manufacturing iron by the puddling process; in the course of which the iron, after it "came to nature," was gathered into balls, and was then removed, as quickly as possible, to the squeezer, where much of the fluid scoria, with other mechanically mixed impurities, was driven out, leaving a mass, or billet of iron, composed of thousands of separate fragments of metal, the entire surface of every one of which was, more or less, coated with dry oxide, or fluid silicate of the oxide of iron. The great pressure exerted by the squeezer sufficed to so far remove the fluid coating of the contiguous particles as to bring their surfaces into actual contact, and consequently to effect an union at such parts. But the whole of the matter thus displaced could not find its way between the interstices of the mass, and therefore it became locked in its numerous cavities, producing points of weakness and separation in the metal. No amount of after working, or rolling, could wholly displace the portions of cinder, dry oxide of iron and of sand, which thus became mixed up with and were diffused throughout the mass, causing flaws and cracks in the iron, all, more or less, objectionable.

Now, if these imperfections were the natural and inevitable consequences of the conditions under which malleable iron was at present produced, it followed that defects of a similar character must also of necessity exist in steel, produced by the puddling process. The granular condition of the metal and its exposure to heat and oxygen, could not fail, in both cases, to oxydise the entire surfaces of the numerous molecules to be united into one mass; the admixture of scoria and other matters, from the furnace, was equally certain to result; and also the difficulty of bringing each particle of the metal to the same degree of decarbonization and refinement existed as in the making of iron, with the additional inconvenience arising from some portions of the metal becoming entirely decarbonized, and being converted into soft malleable iron.

Iron thus presented a most unfavourable contrast with the other malleable metals, all of which were free from sand, or scoria: they had no hard and soft parts, and required no welding together of separate molecules, but they were perfectly homogeneous, and free from all mechanical admixture with foreign substances. Gold, silver, copper, zinc, tin, and lead owed this valuable exemption from the defects universally found in puddled iron, simply to the fact that they were purified and refined in a fluid state, and while still fluid were formed into ingots, whereby the cohesion of every particle in the mass was insured. If then, she refining of other malleable metals, while in a fluid state, and their formation into cast ingots, rendered all such metals more sound and homogeneous than iron, while it did not lessen their extreme ductility, why should iron for ever remain an exception to the general rule? It might be truly answered, that hitherto the excessively high temperature required to fuse and to maintain pure iron in a fluid state, had interposed an insuperable barrier, for the highest heat of the furnaces only sufficed to show that fluidity was a possible condition of that metal.

It need not therefore be a matter of surprise, that when Mr. Bessemer first proposed to convert crude pig-iron into malleable iron, while in a fluid state, and to retain the fluidity of the metal, for a sufficient time to admit of its being cast into moulds, without the employment of any fuel in the process, his proposition was looked upon by many as a chimera, or as the mere day dream of an enthusiast; but it was nevertheless fully recognised and supported by many of the scientific men of the day. The same deep conviction of the truth on which the new process was based, and which led Mr. Bessemer to bring it before the British Association, in 1856, had since determined him (in spite of the opinions then pronounced against the process) to pursue one undeviating course until the present time, and to remain silent for years, under the expressed doubts of those who predicted its failure, rather than again bring forward the invention until it had been practically and commercially worked; and there had been produced by it both iron and steel, of a quality which could not be surpassed by any iron or steel made by the tedious and expensive processes now in general use.

The want of success which attended some of the early experiments was erroneously attributed, by some persons, to the "burning" of the metal, and by others to the absence of cinder, and to the crystalline condition of cast metal. It was almost needless to say, that neither of the causes assigned had anything to do with the failure of the process, in those cases where failure had occurred. Chemical investigation soon pointed out the real source of difficulty. It was found that, although the metal could be wholly decarbonised, and the silicum be removed, the quantity of sulphur and of phosphorus was but little affected; and as different samples were carefully analysed, it was ascertained that red shortness was always produced by sulphur, when present to the extent of 1-10th per cent., and that cold shortness resulted from the presence of a like quantity of phosphorus; it, therefore, became necessary to remove those substances. Steam and pure hydrogen gas were tried, with more or less success, in the removal of sulphur, and various fluxes, composed chiefly of silicates of the oxide of iron and manganese, were brought in contact with the fluid metal, during the process, and the quantity of phosphorus was thereby reduced. Thus many months were consumed in laborious and expensive experiments; consecutive steps in advance were made, and many valuable facts were elicited. The successful working of some of the higher qualities of pig-iron caused a total change in the process, to which the efforts of Messrs. Bessemer and Longsdon were directed. It was determined to import some of the best Swedish pig-iron, from which steel of excellent quality was made, and tried for almost all the uses for which steel of the highest class was employed. It was then decided to discontinue, for a time, all further experiments, and to erect steel works at Sheffield, for the express purpose of fully developing and working the new process commercially, and thus to remove the erroneous impressions so generally entertained in reference to the Bessemer process.

In manufacturing tool steel the highest quality it was found preferable, for several reasons, to use the best of Swedish pig-iron, and, when converted into steel by the Bessemer process, to pour the fluid steel into water, and afterwards to remelt the shotted metal in a crucible, as at present practised in making blister steel, whereby the small ingots required for this particular article were more perfectly and more readily made.

It was satisfactory to know that there existed in this country vast, and, apparently, inexhaustible beds of the purest ores, fitted for the process. Of the Hematite alone, 970,000 tons were raised annually, and this quantity might be doubled, or trebled, whenever a demand arose. It was from the Hermatite pig-iron, made at the Workington Iron Works, that most of the larger samples of iron and steel exhibited were made. About 1 ton 13 cwt. of ore, costing 10s. per ton, would yield 1 ton of pig metal, with 60 per cent. less lime, and 20 per cent. less fuel, than were generally consumed when working inferior ores; while the furnaces using this ore alone yielded from 220 to 240 tons per week, instead of, say 160 to 180 tons per week when workiug with common iron-stone. The Cleator Moor, the Weardale, and the Forest of Dean Iron Works, also produced an excellent metal for this purpose.

The form of converting-vessel, which had been found most suitable, somewhat resembled the glass retort used by chemists for distillation. It was mounted on axes, and was lined with "Ganister," or road drift, which lasted during the conversion of thirty or forty charges of steel, and was then quickly and cheaply repaired, or renewed. The vessel was brought into an inclined position, to receive the charge of crude iron, during which time the tuyeres were above the surface of the metal. As soon as the whole charge was run in, the vessel was moved on its axes, so as to bring the tuyers below the level of the metal, when the process was at once brought into full activity, and twenty small, though powerful, jets of air sprung upwards through the fluid mass; the air expanding in volume, divided itself into globules, or burst violently upwards, carrying with it a large quantity of the fluid metal, which again fell back into the boiling mass below.

The oxygen of the air appeared, in this process, first to produce the combustion of the carbon contained in the iron, and at the same time to oxydise the silicum, producing silicic acid, which uniting with the oxide of iron, obtained by the combustion of a small quantity of metallic iron, thus produced a fluid silicate of the oxide of iron or "cinder," which was retained in the vessel, and assisted in purifying the metal. The increase of temperature which the metal underwent, and which seemed so disproportionate to the quantity of carbon and iron consumed, was doubtless owing to the favourable circumstances under which combustion took place. There was no intercepting material to absorb the heat generated, and to prevent its being taken up by the metal, for heat was evolved at thousands of points, distributed throughout the fluid, and when the metal boiled, the whole mass rose far above its natural level, forming a sort of spongy froth, with an intensely vivid combustion going on in every one of its numberless, ever changing cavities. Thus, by the mere action of the blast a temperature was attained in the largest masses of metal, in ten or twelve minutes, that whole days of exposure in the most powerful furnace would fail to produce.

The amount of decarbonisation of the metal was regulated, with great accuracy, by a meter, which indicated on a dial the number of cubic feet of air that had passed through the metal; so that steel of any quality or temper could be obtained with the greatest certainty. As soon as the metal had reached the desired point (as indicated by the dial), the workmen moved the vessel, so as to pour out the fluid malleable iron, or steel, into a founder's ladle, which was attached to the arm of a hydraulic crane, so as to be brought readily over the moulds. The ladle was provided with a fire-clay plug at the bottom, the raising of which, by a suitable lever, allowed the fluid metal to descend in a clear vertical stream into the moulds. When the first mould was filled, the plug valve was depressed, and the metal was prevented from flowing until the casting ladle was moved over the next mould, when the raising of the plug allowed this to be filled in a similar manner, and so on, until all the moulds were filled.

The casting of large masses of a perfectly homogeneous malleable metal into any desired form rendered unnecessary the tedious, expensive and uncertain operation of welding now employed wherever large masses were required. The extreme toughness and extensibility of the Bessemer iron was proved by the bending of cold bars of iron, 3 in. square, under the hammer into a close fold, without the smallest perceptible rupture of the metal at any part; the bar being extended on the outside of the bend from 12 in. to 16¾ in., and being compressed on the inside from 12 in. to 7¼ in., making a difference in lenght of 9½ in. between what, before bending, were the two parallel sides of a bar 3 in. square. An iron cable, consisting of four strands of round iron, 1½ in. diameter, was so closely twisted, while cold, as to cause the strands at the point of contact to be permanently imbedded into each other. Each of these strands had elongated 12½ in. in a length of 4 ft., and had diminished one-tenth of an inch in diameter, throughout their whole length. There were also exhibited some steel bars, 2 in. square, and 2 ft. 6 in. in length, twisted cold into a spiral, the angles of which were about 45 degrees; and some round steel bars, 2 in. in diameter, bent cold under the hammer, into the form of an ordinary horseshoe magnet, the outside of the bend measuring 5 in. more than the inside.

The steel and iron boiler plates, left without shearing, and with their ends bent over cold, also afforded ample evidence of the extreme tenacity and toughness of the metal; while the clear even surface of the railway axle and piece of malleable iron ordnance were examples of the perfect freedom from cracks, flaws, or hard veins, which formed so distinguishing a characteristic of the new metal. The tensile strength of this metal was not less remarkable, as the several samples of steel tested in the proving-machine, at Woolwich Arsenal, bore, according to the reports of Colonel Eardley-Wilmot, R.A., a strain varying from 150,000 lbs. to 162,900 lbs. on the square inch, and four samples of iron boiler-plate from 68,314 lbs. to 73,100 lbs.; while, according to the published experiments of Mr. W. Fairbairn, Staffordshire plates bore a mean strain of 45,000 lbs., and Low Moor and Bowling plates, a mean of 57,120 lbs. per square inch.

There was also another fact of great importance in a commercial point of view. In the manufacture of plates for boilers and for ship-building, the cost of production increased considerably with the increase of weight in the plate; for instance, the Low Moor Iron Company demanded £22 per ton for plates weighing 2½ cwt. each, but if the weight exceeded 5 cwt., then the price rose from £22 to £37 per ton. Now, with cast ingots, such as the one exhibited, and from which the sample plates were made, it was less troublesome, less expensive, and less wasteful of material, to make plates weighing from 10 to 20 cwt. than to produce smaller ones, and indeed there could be but little doubt that large plates would eventually be made in preference, and that those who wanted small plates would have to cut them from the large ones. A moment's reflection would therefore show the great economy of the new process, in this respect; and when it was remembered that every riveted joint in a plate reduced the ultimate strength of each 100 lbs. to 70 lbs., the great value of long plates for girders and for ship-building would be fully appreciated.

At a time when the manufacture of ordnance occupied so large a share of public attention, it was interesting briefly to point out the great facility which the Bessemer process afforded of forming masses, both of malleable iron and of steel, of a size suitable for the heaviest ordnance, without any welding together of separate slabs, or the more costly mode of building up the gun with pieces accurately turned and fitted together. Many attempts had been made to produce wrought-iron ordnance, and this object had been successfully accomplished in the case of the large gun produced at the Mersey forge. But, however perfect this one gun might be, the time required to make it, and its immense cost, manifestly rendered it still a great desideratum to produce guns rapidly and cheaply of a material equal to, or greater in tensile strength than wrought iron, and, if possible, free from the liability which that material had to flaws and to deterioration, during its long exposure to a welding heat. It was believed that the Bessemer process supplied this desideratum, as masses of cast malleable metal could be produced of 10 or 20 tons in weight in a single piece, and two or three such pieces might be conveniently made by the same apparatus in one day. The metal so made might be either soft malleable iron or soft steel. In order to prove the extreme toughness of such iron, and the strain to which it might be subjected without bursting, several cast and hammered cylinders were placed cold under the steam-hammer and were crushed down without the least tearing of the metal, as was shown by the samples exhibited. These cylinders were drawn from a round cast-iron ingot of only 2 in. greater diameter than the finished cylinder, and in the precise way in which a gun would be treated; they might, therefore, be considered as short sections of an ordinary 9-pounder field-piece. The tensile strength of the samples, as tested at the Royal Arsenal, was 64,566 lbs. per sq. in., while the tensile strength of pieces cut from the Mersey gun gave a mean of 50,624 lbs. longitudinally, and 43,339 lbs. across the grain; thus showing a mean of 17,550 lbs. per sq. in. in favour of the Bessemer iron.

If it was desired to produce ordnance by merely casting the metal, the ordinary founding process might be employed with the simple difference, that the iron, instead of running direct from the melting furnace into the mould, must first be run into the converting vessel, where in ten minutes it would become steel, or malleable iron, as was desired, and the casting might then take place in the ordinary manner. The small piece of ordnance exhibited served to illustrate this important manufacture; and it was interesting, in consequence of its being the first gun that was ever made in malleable iron without a weld or joint. The importance of this fact would be enhanced when it was known that conical masses of this pure tough metal, of from 5 to 10 tons in weight, could be produced at Woolwich at a cost not exceeding £6 12s. per ton, inclusive of the cost of pig iron, carriage, remelting, waste in the process, labour, and engine power. The conical ingots being cast in iron moulds, the great delay in moulding in loam would be avoided; and as the iron moulds employed might be removed from the casting-pit within an hour after the metal had been poured into them, the tedious interval of three days now required by the cast-iron guns before removal would be also avoided, thus immensely increasing the capabilities of the foundry.

If it was assumed that these advantages were about equal to the cost of hammering the cast ingot, then, by this process, it would be practicable to produce guns of any size, in hammered cast steel, or malleable iron, ready for the boring-mill, at about the same cost as the cast-iron guns now in use; but if the weight of the guns could be reduced by 20 or 25 per cent., in consequence of their superior strength, then an actual saving in that proportion would be effected in the first cost of every gun so made. These important facts had been laid before the Government, and their advantages were stated to be fully appreciated by Colonel Eardley-Wilmot, the superintendent of the Royal Gun Factories, who had evinced a great interest in the progress of the invention from its earliest date, and to whose kindness the author was indebted for the many valuable trials of the tensile strength of the various samples of metal that had been submitted for investigation.

It would be interesting to those who were watching the advancement of the new process to know that it was already rapidly extending itself over Europe. The firm of Daniel Elfstrand and Co., of Edsken, who were the pioneers in Sweden, had now made several hundred tons of excellent steel by the Bessemer process. Another large manufactory had since been started in their immediate neighbourhood, and three other companies were also making arrangements to use the process. The authorities in Sweden had fully investigated the whole process, and had pronounced in favour of it. The large steel circular saw plate exhibited was made by Mr. Göranson, of Geffle, in Sweden, the ingot being cast direct from the fluid metal, within fifteen minutes of its leaving the blast furnace. In France, the process had been for some time carried on by the old established firm of James Jackson and Son, at their steel works, near Bordeaux. This firm was about to manufacture puddled steel, on a large scale. They had already got a puddling furnace erected and in active operation, when their attention was directed to the Bessemer process, the apparatus for which was put up at their works last year; and they were now extending their field of operations by putting up more powerful apparatus at the blast furnaces in the Landes. There were also four other blast furnaces in the south of France in course of erection, for the express purpose of carrying out the new process.

The irons of Algeria and Saxony had produced steel of the highest quality.

Belgium was not much behind her neighbours; the process was now being carried into operation at Liege, where excellent steel had been made from the native coke iron; while in Sardinia preparations were also being made for working the system. Russia had sent to London an engineer and a professor of chemistry to report on the process, and Professor Müller of Vienna, and M. Dumas and others from Paris, had visited Sweden, to inspect and report on the working of the new system in that country.

The Bessemer process might therefore be now fairly considered an accomplished commercial fact, and in a country like England, where the manufacture of iron and steel formed so important a branch of the national industry, and was so necessary an element in all the great manufacturing operations, it must be admitted that an impartial examination of the new system was of the highest importance, not only to those immediately concerned in the production of malleable iron and steel, but to the country generally.

That the process admitted of further improvement, and of a vast extension beyond its present limits the author had no doubt; but those steps in advance would, he imagined, result chiefly from the experience gained in the daily commercial working of the process, and would most probably be the contributions of the many practical men who might be engaged in carrying on the manufacture of iron and steel by this system. Hitherto the process had been brought into its present practical and commercial state, without recourse to any of the numerous inventions which were supposed by the several authors to be essential to the success of the system; but any real improvement that might be brought forward would be cordially received and encouraged.

ASSOCIATION OF FOREMEN ENGINEERS.

Mr. J. Newton in the Chair.

On Saturday the 4th ult., the Association of Foremen Engineers held their ordinary meeting at the "Bay Tree Rooms," City of London. The main portion of the interest on this occasion centred in the adjourned discussion upon Mr. Briggs' paper of last month, on the "Concussion of Water." After the election of two auditors—Messrs. Hosken and Stabler,—Mr. Briggs, armed with a supplementary paper further illustrative of his subject and somewhat extending its bearing, reopened the debate, and by practical allusions to hydraulic rams, pump valves, and other hydrostatic appliances, made his views yet more plain, and his deductions more conclusive. Mr. Warner and other speakers followed, most of them in terms confirmatory of the statements of the writer of the Paper, and laudatory of his care in arranging it. Regret was expressed at the non-appearance at their purely benevolent and scientific gatherings, of the heads of firms, and this was shared in by Mr. Joseph Newton, who appealed once more to the liberal feelings of employers generally. It needed, he said, but their countenance to make the Association of Foremen Engineers one of the most flourishing societies in London.

After a vote of thanks to Mr. John Briggs, and the announcement of a Paper on the first Saturday in July by Mr. Stabler, "On the Economical Formation of Steam," the meeting separated.

SILK CONDITIONING.

We have recently had several inquiries respecting the conditioning of silk, and as some of our correspondents have desired to be furnished with whatever information could be obtained for them, we applied to Mr. Crace Calvert, of Manchester, who has kindly furnished us with the following information upon the subject, and supplied two of the forms used in connection with the operation.

To the majority of our readers, probably, the term "Silk Conditioning" will sound strangely; and even by some of those who are engaged in the silk trade it will be but imperfectly understood, the process having been but recently introduced into London and Manchester, although it has long flourished at Lyons, Paris, Turin, Milan, Elberfeldt, St. Etienne, Zurich, &c.

To understand the principle of conditioning, it is necessary to bear in mind that silk in its raw, as well as in its manufactured state, when subject to atmospheric influences, has a great affinity for moisture, so that if a quantity be artificially dried, and then left in a damp atmosphere, it will, in a very short time, acquire an increase of weight of from 10 to 15, or perhaps even 20 per cent.; the amount of this increase depending of course very much upon the state of the atmosphere in which it is placed. It will be at once apparent that this property is one that offers great facilities to unscrupulous persons for dishonestly increasing the weight of the article they wish to sell, and the high price which silk bears in the market, makes the temptation to use this facility often irresistible. Independently of this, however, the natural fluctuations of humidity in the atmosphere are sufficient to cause great variations in the "condition" of silk, and thus introduce into transactions an element of uncertainty which it is very desirable to avoid if possible. It is manifestly useless to employ expensive scales for the purpose of ascertaining weight *to an ounce*, while there exists all the time a source of error to the extent, perhaps, of *pounds*. An establishment for conditioning silk has therefore been opened in Manchester, under the approval of twenty-three firms engaged in the trade. A short description of the process employed there will, doubtless, prove interesting.

When a lot of raw or thrown silk has been purchased, with the understanding that it shall be conditioned, it is sent by the seller to the conditioning-house. There the silk is carefully weighed to a dram, and about 3 lbs. of it are taken from various parts of the bales or bundles composing the parcel. The remaining quantity is put into strong tick bags, the open ends of which are carefully secured and sealed, so that no one can open them without detection. The bags of silk are weighed, an invoice given, and then delivered to the purchaser. The 3 lbs. of silk reserved for conditioning are divided into three lots, and each lot is weighed in a most delicate balance, turning with 1-100 of a grain, and every weighing in the establishment is always checked by a second person, to avoid any chance of error. Two of the above-weighed lots are introduced into a drying apparatus, heated to 230 degrees, and left there until the silk has lost all its moisture. This is ascertained by a pair of delicate scales placed upon the drying apparatus. If the loss of moisture of the two samples agrees within 0·5 per cent., or 5-1000, the conditioning is considered good, but if the difference of loss is greater, the third sample is dried, and the mean of the three results taken; generally, the loss on two samples is within 0·1 or 0·2 per cent. The amount of loss on the above weights is calculated on the bulk sent in, and 11 per cent. (the proportion admitted by the trade) of moisture is added to the perfectly dry silk; the weight resulting is the weight of silk as conditioned. We shall give here, for the information of the silk manufacturers, the highest, lowest, and average quantities of water which the silk has lost, and the highest, lowest, and average proportions of water which the silk has contained above the conditioned weight, which will show at once the advantage to all engaged in the trade of having silk conditioned as a preventative against fraud and purloining:—

CHINA ORGANZINE.

	Total loss per cent.		Excess of moisture per cent. above conditioned weight.
Highest	15·750	....	6·935
Lowest	8·569	....	1·455 below conditioned weight.
Mean	11·983	....	2·499 above "

CHINA TRAM.			CHINA SINGLES.		
Highest	15·170	6·203	Highest	14·024	4·775
Lowest	10·115	0·234	Lowest	11·341	1·602
Mean	12·192	2·623	Mean	12·051	2·441
CHINA RAW.			**BENGAL ORGANZINE.**		
Highest	11·886	2·241	Highest	19·773	12·292
Lowest	9·827	0·089	Lowest	12·432	2·883
Mean	11·106	1·413	Mean	14·109	4·974
ITALIAN ORGANZINE.			**ITALIAN RAW.**		
Highest	12·008	2·385	Highest	10·703	0·888
Lowest	10·591	0.764	Lowest	10·591	0·764
Mean	11·246	1·509	Mean	10·641	0·826

But this is not the only benefit which this establishmeut confers on the silk consumer, for we find that the quantity of soap and gum which the thrown China silks lose by boiling often reaches a very high figure — far above the 25 per cent. which they are expected to yield to water when boiled in it.

CHINA ORGANZINE. Losses by boiling off.	Per cent.	CHINA TRAM. Losses by boiling off.	Per cent.
Highest	29·273	Highest	29·811
Lowest	23·989	Lowest	23·545
Mean	26·612	Mean	26·707

Therefore, if we take the excess of water contained in thrown silk, and the excess of soap above 25 per cent., which may be considered more than a fair average (raw silk only losing about 21 per cent.), we find that by conditioning and boiling off silk, a consumer of silk will save on an average $4\frac{1}{4}$ per cent. This statement, however, is probably very far short of the real gain, since it has been clearly ascertained that some sellers, when they knew that their silk was to be conditioned, have purposely dried it, to induce the buyers to look upon conditioning as an unnecessary expense. This cause will, no doubt, generally operate to lessen the apparent gain from conditioning, because no one will take the trouble to increase the weight of his silk artificially, when the process of conditioning is certain to render that trouble useless.

The following Tables will not only show how largely the Lyons manufacturers *voluntarily* avail themselves of the conditioning-house, which has been established for so many years, but also the relative quantities of French and foreign silks which have been conditioned in Lyons during the last ten years:—

Extracts of proceedings of the conditioning-house of Lyons during 10 preceding years. Proportion of foreign silk conditioned during the 10 preceding years.

Years.	Numbers.	Kilogrammes.	Years.	Numbers of lots of silk.	Proportion per Cent. of the total of the year.
1847	23,326	1,697,987	1847	4,753	22·86
1848	17,581	1,408,368	1848	2,408	15·05
1849	25,249	2,097,846	1849	5,815	25·49
1850	25,500	2,066,662	1850	5,910	25·64
1851	24,024	1,897,786	1851	5,876	24·45
1852	28,155	2,289,831	1852	8,181	31·30
1853	35,060	2,839,499	1853	8,724	26·66
1854	31,345	2,375,387	1854	7,424	25·83
1855	39,251	3,044,312	1855	7,464	20·72
1856	38,601	2,909,526	1856	11,313	29·30

With these results in view, it is difficult to believe that English manufacturers and silk consumers will be long before they adopt this plan, which is so universally and voluntarily practised on the continent.

The following are the forms above referred to as in use in the Manchester establishment; the first is a form of certificate, the second a receipt specifying particulars of the original condition, and the result of the operations upon the samples sent for treatment.

Manchester Silk and Wool Conditioning Establishment.

No.

Wrapping Department, 90, Mosley Street.

Sample 185

Marked

Sent by

Lots.	Weight in Grains.	Conversion into Deniers.	Observations
1st........			
2nd........			
3rd........			
4th........			
5th........			
6th........			
7th........			
8th........			
9th........			
10th........			
11th........			
12th........			
Mean			Charge for Wrapping 1s.

Note.—The Lots are 520 yards. The Denier is equal to 0·82 Grain.

The following is the official certificate and receipt returned with the silk after treatment.

Manchester Silk and Wool Conditioning Establishment.

Duplicate No.

MARKS.

90, Mosley Street, 185

Received from M

	Lbs.	Oz.	Drams.
Weighing, Gross..........			
Tare..........			
Net..........			
Grains.			
Original Weight of Samples for conditioning..........			
Reduced ditto ditto			
lbs. Oz. Dr.			
Diminution, or per cent., which on 0 0 0 is..			
Add 11 per cent..........			
Conditioned weight..........			
Diminution..........			
Lbs. Oz. Dr.			
0 0 0 Samples returned..........			

(*Signature*)

ON THE PROGRESSIVE APPLICATION OF MACHINERY TO MINING PURPOSES.

By Mr. Thomas John Taylor, of Earsdon, Newcastle-on-Tyne.

In the following Paper an attempt is made to trace the progressive application of Machinery to Mining purposes; more especially to the drainage of mines and raising of coal in the Newcastle coal district; a subject which must, it is conceived, prove interesting both to the mining and mechanical engineer, as involving not only one of the earliest employments of the steam engine, but also the first extensive use, if not the invention of railways.

The inclined position of beds of coal is intimately connected with the mechanical means required for working and draining them. In some cases the beds rise or crop out to the surface or "day," as it is called, and in others they are buried with the associated strata at considerable depths below. As these strata rise from depths of 100, 200, 300 fathoms and upwards, along an inclined plane, broken by faults and interruptions, but still ultimately making their way out to the day, it is obvious that depth is a principal element in the consideration of the mechanical means required for working and draining the coal beds. In the "shoaler" mines, or those worked near the surface, the lifting of water, which is uudoubtedly the miner's greatest enemy, is comparatively easy; so also is the raising of the coal to the surface; and, it may be added, the ventilation; for inflammable gas is hardly ever met with in mines worked near the day, though carbonic acid gas, known to miners as "stithe" or choke damp, is abundant in such mines. There are thus three distinct requirements for all mines—drainage, raising of the coal, and ventilation; but their nature and extent vary in different portions of a coal field, and hence become characteristic of particular epochs. By the old miner, the "old man," as he is called, who cannot be accused of any want of shrewdness in comprehending his position, the shallow mines were easily worked, and drained by adits, many of the coal beds being found above the natural drainage levels of the country: in a middle period when deeper mines were to be worked, a perpetual struggle arose for the necessary mechanical powers, a struggle resulting in many contrivances, some of which were, as will be seen, very ingenious; and thirdly, we arrive at the epoch of the steam-engine, which has ever since continued to be the right arm of mining operations, and has also led to many other mechanical appliances as a natural consequence of the development it has given to mining.

Early period of Coal Mining. The earliest and simplest plan of coal mining was that of a day drift or adit, along which both water and coals were brought, as shown in the diagram, Fig. 1, Plate 1: the coals were carried in the workings by men or boys, first by hand or on their backs, and afterwards, as an improved step, on sledges which were trailed along the "thrill" or floor. The shafts sunk on the continuation of the forward workings supplied what ventilation was supposed to be needed, and were surmounted by the common winch or jack-roll worked by hand. The mode of conveyance from the pit was on the backs of horses or donkeys, which carried what is still called a "load" in some outlying districts: the pack-horse load, weighing about $2\frac{1}{2}$ cwts., being the same in fact as the "coal boll," of which it is the origin; and the name carries us back to that not very remote period when there were neither railroads nor even accessible carriage roads for purposes of transit.

The early period of active coal mining in England extends from the twelfth to the beginning of the seventeenth century. There are many curious notices of coal in these times; amongst which may be mentioned that in the fourteenth century coals were sent from Newcastle to be used in sharpening the tools of the workmen employed in building Windsor Castle; coals having been made use of for smiths' and manufacturing purposes long before they were introduced for domestic consumption. To the latest portion of this period, namely, the commencement of the seventeenth century, may be referred the employment of horses in drawing coals and water by whim gins: by this substitution of horses for manual labour an additional power was gained. But the coal beds were becoming so rapidly exhausted near the outcrops, that in the year 1610 Sir George Selby declared in his place in parliament, for the grave consideration of the legislature, that the Newcastle coal field would be worked out in a period of twenty-one years. To us, who continue to raise, two centuries and a half after his time, 16 millions of tons yearly from this coal field, such a statement appears remarkable enough; but the speaker alluded, it must be supposed, to the working out of the accessible portions of the coal field, and his observation denotes the near approach of a period when it would be necessary to win the deeper coal; an object which, however desirable, there were at that time absolutely no known means of accomplishing.

With a view fully to appreciate the nature of the difficulties which the early mining adventurers had to encounter in regard to drainage, it may here be mentioned that, as a general rule, a greater weight of water than of coal is raised to the surface in the mines of Northumberland and Durham. In particular cases, such as that of Wylam Colliery and Percy Main Colliery near Newcastle, the weight of water raised has been nearly 30 times that of coal: in other cases 7 or 8 times the weight of coal. To very deep mines, especially when the top feeders have been stopped back by cast-iron caissons or tubbing, this remark does not apply: but still, as a general and average result, a greater weight of water than of coal is required to be raised, without taking into account those cases in which water is found to excess, as in the half-indurated marly sand beneath the magnesian limestone of the county of Durham.

Middle period of Coal Mining.—In the middle period of coal mining, or during the whole of the seventeenth and commencement of the eighteenth century, there was a perpetual struggle to obtain some mechanical power which might prove adequate to win and work the mines lying to the deep. In the absence of this power attempts were made to stop back the top feeders by caissons or "tubing" as it was called. The first attempt of this kind is mentioned by William Waller, in his account of the mines of Sir Carbery Price, 1698. In the preface to this work he ascribes to Sir Humphrey Mackworth the credit of applying, at his mines in Glamorganshire, "a *new* method of coffering out the water from his shafts and sinking pits, and thereby preventing the charges of water engines, and also recovering a large vein of coal by that means, which was in vain attempted by other artists." In the "Complete Collier," published in 1708, is a description of "the stopping back of shaft feeders with wooden frames;" and the author (name unknown) also says that he has heard of "iron frames that have been used at Harraton, in Durham, made square and deeper than the thickness of the quicksand, to put back these quicksands, which may be of good use, though they must be dear." It was not however until 1795 that cast-iron tubing came much into vogue: in that year Mr. Barnes employed it at Walker Colliery near Newcastle, the pieces consisting of entire circular rims the size of the shaft. In 1796 Mr. Buddle adopted the more convenient plan of segments, at first connected together by screw bolts, but afterwards by wedging the joints, each segment constituting in fact the voussoir of a circular arch. By this means very large water feeders are dammed back, giving in some cases a pressure of 300 ft. to 500 ft. head of water.

In reference to the introduction of machinery, the "Complete Collier" (1708) furnishes a clear view of the state of mining at that time: it states, "in some places we draw water by water, with water wheels or long axle-trees, but there is not that convenience of water everywhere." The long axle-trees referred to worked chain pumps, as shown in the old sketch Fig. 2, Plate 1: an endless chain turned upon a large axle, having attached to it a number of oblong wooden buckets or troughs, which filled at the bottom of the pit and discharged at the top as they turned over the great axle-tree. When there was sufficient water for working the wheel, the full complement of buckets was placed upon the chains; but as the water decreased, a proportionate number of alternate buckets were detached, for the purpose of regulating this rude machine according to the power available. None of the buckets were more than half full at the time of discharging at the top, owing to the leakage and the vibration of the chains, the water continually pouring down the pit like a deluge. Wind was also employed as a moving power: but then, as the author of the "Complete Collier" remarks, "the wind blows not to purpose at all times." Under these circumstances he falls back upon the methods then in use as being the best, namely the jack-roll and the horse gin; which last, provided with tubs and worked by two horses, "is found to be more serviceable and expeditious to draw both water and coal than any other we have seen in these parts yet." He is however obliged reluctantly to admit that he and his brethren knew of no means of draining "the good collieries which lie unwrought and drowned;" and that those who could discover such methods might, as he says, "keep their coach and six, for we cannot do it by our engines." But it is curious enough to observe that in speaking of the steam engine, then in its birth era, which was destined to realise the desideratum he had so much at heart, as well as so many other great objects, he expresses himself, as others have done both before and since his time, with caution and reserve respecting this new discovery. "There is," he says, "one invention of drawing water by fire, which we hear of, and perhaps doeth work to purpose, in many places and circumstances; but in these collieries hereaway I am afraid there are not many dare venture upon it, because nature doth generally afford us too much sulphurous matter to bring more fire within these our deep bowels of the earth, so that we judge cold inventions of suction and force would be safest for this our concern."

(*To be continued.*)

ROUEN DISTRICT INDUSTRIAL EXHIBITION.

An exhibition, upon an extensive scale, of the various industrial products of the north-east district of France, comprising the following departments:—Nord, Pas de Calais, Aisne, Soumme Seine, Inferieure, Eure, Calvados, Orne, Mauche, Meyenne, and Sarth, is about to be opened at Rouen; the 4th of July being the day fixed for the opening ceremony.

The idea originated with, and the project has been carried into execution by the Society for the Encouragement of Commerce and Industrie of the Seine Inferieure, an institution that has exhibited considerable spirit in the carrying out of the objects with which it was originally established, and by its liberality great encouragement has been offered to all undertakings likely to benefit the north-east district of France in particular, and the country in general

The space occupied by the "Industrial Palace," which has been specially constructed for the purpose, for which it is admirably adapted, and in design both handsome and appropriate, is about 16,500 square metres.

The number of exhibitors is about 1,500 to 1,600.

It is anticipated that the opening ceremony, to take place on the 4th of July, will be a brilliant affair.

ENGINEERS' DEBATING SOCIETY.

A society has recently been established for the purpose of discussing practical, mechanical, and engineering subjects. Their place of meeting is 38, Arbour Square, Stepney. Mr. E. H. Hillier being the Hon. Secretary.

REVIEWS AND NOTICES OF NEW BOOKS.

Three Lectures on the Rise and Progress of Civil and Mechanical Engineering and Popular Education. By W. Fairbairn, C.E., F.R.S., F.G.S., &c. Derby, 1859.

The two first of these lectures were delivered before the Mechanics' Institution, the Railway Literary Institution, and the Working Mens' Association, at Derby; the last contains the subject matter of an inaugural address delivered before members of the Blackburn Mechanics' Institute in November last; these lectures are illustrated with thirteen lithograph views of engines and machinery of various kinds, which being published with the text, add considerably to the value of the publication of these lectures in their present form.

The locomotive department of the Midland railway, and other officers connected with the Midland Railway Company, taking considerable interest in their local and other Mechanics' Institutions, requested to be allowed to print and circulate the lectures in a cheap form for the benefit of the Local Institutions, and Mr. Fairbairn having very kindly consented, the three lectures have been published at a cost of 1s. per copy, and we must confess that the 50 pages of letter-press and 14 plates, should alone be sufficient to ensure an enormous sale; but, when we add that the *matter* of the 50 pages of letter-press contains a vast amount of very valuable in formation, as may be readily supposed, coming from so eminent a man as Mr. W. Fairbairn, the wonder is, that the price was not 5s.

High Speed Steam Navigation and Steamship Perfection, &c. By Robert Armstrong. London: Spon, pp. 89.

Mr. Robert Armstrong, the author of the present pamphlet, is so well known to our readers, as also are his views upon steam-ship performance, and such like matters, that it is unnecessary for us to do more than to announce the publication in a collected form of the numerous letters contributed to The Artizan, and papers submitted by him to, and read at, the Institution of Civil Engineers, together with some later papers and suggestions upon the same subject.

The present work is very appropriately dedicated to Vice-Admiral Moorsom, Deputy Chairman of the London and North-Western Railway; Chairman of the Committee of the British Association for the Investigation of Steam-ship Performance, &c., than whom no one has paid more attention to these subjects, or has done more for the scientific and systematic investigation of marine and locomotive steam-engine performanees.

We advise every one who takes an interest in the very interesting questions so devotedly and enthusiastically discussed by Mr. Armstrong, to forthwith invest a shilling in the purchase of his work, and proceed to peruse it with the care and attention which it deserves; for although the author entertains peculiar views as to very fundamental principles, no one can doubt his sincerity in his belief, and his ardour and devotion to the subject when propounding his views; this is most strongly evidenced by the large quantity of tabulated information so industriously worked out.

Reid's Mental Arithmetic: containing the Principles of Arithmetic for the Learner, and Numerous Exercises, with the Answers for the Teacher. By Hugo Reid, Author of the Principles of Education, &c. London: Longman, Brown, and Co., 1859.

A very excellent little work, and one which we can with great confidence recommend.

The Carriage Builders' and Harness Makers' Art Journal. London: Tallis and Co. Part 1. Price 2s. 6d.

This is the first part of a series intended to be continued monthly, and contains some very excellent designs for pleasure carriages, and is intended to convey practical directions in all branches of coach-building; to be illustrated with working drawings and coloured illustrations of the most approved designs and patterns of all descriptions of pleasure, domestic, public, railway, and agricultural carriages and wheel vehicles. It is also announced that all new patents and improvements in springs, steps, wheels, axles, and lamps, &c., and all new designs in metal chasings, steel and iron work, silk and lace trimmings, &c. carriage furniture, &c., will from time to time be described, and various other matters connected with carriage building, harness making, saddlery, &c., are to be treated of.

If the present number is to be considered a fair sample of the quality of the work, we cannot too highly commend it for the design and the scale, as well as for the excellent style in which it is brought out.

[Several Reviews and Notices of Books must stand over until next month.—Ed.]

LIST OF NEW BOOKS AND NEW EDITIONS OF BOOKS.

EAST-INDIA REGISTER and Army List for 1859. Compiled by permission. 2nd edit. corrected to the 10th of May, 1859. 12mo. sewed, 10s.; bd. 11s. 6d. (Allen).

HUNT'S Universal Yacht List for 1859. Oblong. bound, 4s. (Hunt).

RAMCHUNDRA. A Treatise on Problems of Maxima and Minima, solved by Algebra: reprinted by Order of the Honourable Court of Directors of the East India Company, under the Superintendence of Augustus De Morgan. 8vo. pp. 200, cloth, 7s. 6d. (W. H. Allen).

STANSFIELD (H.)—Outline of a System of direct Taxation for superseding Customs and Excise Duties, and establishing perfect freedom of Trade: a Letter to the President and Council of the Liverpool Financial Reform Association. By Hamer Stansfield. 8vo. pp. 23, sewed, 2s. 6d. (Simpkin).

BUSK (H.)—The Navies of the World, their present State and future Capabilities. By Hans Busk. 12mo. pp. 430, cloth, 7s. 6d. (Routledge).

COINAGE. Remarks on Coinage; with an Explanation of a Decimal Coinage proposed to be introduced into this Country. By "Jacia." Royal 8vo. pp. 20, sewed, 1s. (Simpkin).

FIELD EXERCISES and Evolutions of Infantry, as revised by Her Majesty's Command, 1859. Pocket edit. oblong, pp. 400, roan, 3s. 6d. (W. H. Allen).

JAMES (W.)—The Naval History of Great Britain, from the Declaration of War by France, in 1793, to the Accession of George IV. By William James. 6 vols. Vol. 2, 12mo. pp. 490, cloth, 5s. (Bentley).

KENNEDY (Lieut.-Gen.)—Notes on the Defences of Great Britain and Ireland. By Lieut.-General Shaw Kennedy. 8vo. pp. 52, sewed, 1s. 6d. (Murray).

MAURY (M. F.)—The Physical Geography of the Sea. By M. F. Maury. An entirely new edition, with Addenda. Post 8vo, pp. 310, cloth, 5s. Philip.

NIGHTINGALE (F.).—Notes on Hospitals; being Two Papers read before the National Association for the Promotion of Social Science at Liverpool, in October, 1858: with Evidence given to the Royal Commissioners on the State of the Army in 1857. By Florence Nightingale. 8vo, pp. 90, cloth, 5s. J. W. Parker.

OUR NAVAL POSITION AND POLICY. By a Naval Peer. Post 8vo, pp. 640, cloth, 12s. Longman.

PHILP (R. K.)—The History of Progress in Great Britain. By Robert Kemp Philp; with numerous Illustrations by W. Newman, C. Melville, J. Gilbert, and H. C. Maguire. 8vo, pp. 400, cloth, 7s. 6d. (Houlston).

RICKARD (W.)—The Miner's Manual of Arithmetic and Surveying: containing the usual Calculations employed by the Miner, those required at the Copper Ticketing, the Mode of Estimating the Value of Ore in a Lode, &c.; with a Compendium of Mensuration, and a concise Treatise on Practical Geometry and Plane Trigonometry. By William Rickard. 8vo, pp. 220, cloth, 10s. 6d. (Longman.)

*EASTON (A.)—A Practical Treatise on Street or Horse-Power Railways; their Location, Construction and Management, with General Plans and Rules for their Organisation and Operation: together with Examinations as to their comparative Advantages over the Omnibus System; and Inquiries as to their Value for Investment: including Copies of Municipal Ordinance relating thereto. By Alexander Easton, C.E. 8vo (Philadelphia, 1859), 23 plates, pp. 149, cloth. London.

*LEAD PIPE. Collection of Reports (condensed) and Opinions of Chemists in regard to the Use of Lead Pipe for Service Pipe in the Distribution of Water for the Supply of Cities. 8vo (New York, 1859), pp. 343, cloth (London), 9s.

*LESLEY (J. P.)—The Iron Manufacturer's Guide to the Furnaces, Forges, and Rolling Mills of the United States; with Discussions of Iron as a Chemical Element, an American Ore, and a Manufactured Article, in Commerce and in History. By J. P. Lesley, Secretary of the American Iron Association, and published by authority of the same with 5 Maps and numerous Plates. 8vo (New York, 1859), pp. 772, cloth (London), 30s.

* American Works.

CORRESPONDENCE.

[*We do not hold ourselves responsible for the opinions of our Correspondents.*—Ed.]

BOYDELL'S TRACTION ENGINE AND ENDLESS RAILWAY.

To the Editor of The Artizan.

Sir,—In the May number of your interesting journal, a very able article on Boydell's Traction Engine appeared, together with an account and description of an engine, which has been working daily from a colliery into Manchester, a distance of eight miles.

This same engine, about the middle of that month, started by road from Manchester, *via* Warrington to Liverpool, where it arrived safely, and has been shipped for Venezuela; and, as no account of the journey has yet appeared, I venture to send you a short narration of the trip, having, in company with a great many engineers and gentlemen, accompanied it during the entire journey.

On the 12th of May being at Manchester, and seeing it announced that the engine and train would leave on that day at 10 o'clock for Liverpool, stopping the night at Warrington, I went down to the yard at Water Street a little before that time, where I found the engine with steam up, and a train of five four-wheeled waggons and two two-wheeled carts attached (the two carts having the endless railway on their wheels) forming a train of great length, fully 130 ft.

The yard was crowded with people, including a great many influential Manchester gentlemen, as well as a number of engineers from Ireland, Wales, and the neighbouring counties, who had been sent by mine and colliery owners, and others who are in the habit of moving large quantities of heavy material to examine the engine and train, and report on its working and capabilities.

The leading waggon contained a ton and a half of coke, as appeared by the bill shown to me, and the others had in them boxes of spare gear and other articles belonging to the train which were going out with it; and these, together with the waggons themselves, made the entire weight behind the engine equal to 19 tons 15 cwts.

Having waited some time beyond the hour appointed, in order to enable some gentlemen coming by train, to see it start, at 10·55 the whistle sounded, and away went the engine and train at about 4 miles an hour out of the yard, amidst the shouts of the assembled crowd, and to the delight of those fortunate gentry who were accommodated with seats in the waggons. The engine turned a sharp corner from Water Street into the Regent Road, followed in the most beautiful manner by the entire train, which moved as though it were guided by flanges on a rail, and went away up an incline of 1 in 26, without the least decrease in the speed, passing the barrack-yard, where a crowd of soldiers were assembled to cheer the train as it passed.

It appears that on the Tuesday before, the engine and train were taken into the barrack-yard, turning at a right angle off the main road through a gateway into the yard, with only a few inches to spare on either side of the waggons and engine, and proceeded up to the end of the yard where it was turned, with the whole train, without stopping, in a space less than 36 ft. in width, and not the least mark of such a thing having been in could be seen, the only mark visible being the track of the wheels of the waggons. The regiment quartered in these barracks is the 22nd, which has just returned from India, and both officers and men were deeply impressed with the enormous advantage a proper establishment of these engines and trains would give for moving troops, guns, and stores in that country. One serjeant, a very intelligent man, remarked "that he had no doubt hundreds of soldiers would have been preserved if they could have been removed by these engines and trains, instead of marching under a burning sun, and dying from exposure and exhaustion; and that, for his part, he most sincerely hoped they would soon come into use for that purpose." A wish I most cordially echo, having been thoroughly convinced of its capability of perfect and easy arrangement, long before we got to Liverpool.

The train, accompanied by an enormous crowd on foot, on horseback, in carts, gigs, and carriages, went steadily along the road, greeted by the shouts of the lookers-on, who were assembled at every point that could give them standing room and a view of the passing train, as well as at every door and window, passing carts and horses without inconvenience, and continued its journey until it arrived at Peel Green, exactly two hours from leaving Manchester. Here it was determined to take in water, and the inner man having also a desire for something substantial, as well as liquid, a general halt was made, *nem. con.*, the weather being exceedingly hot and the roads terribly dusty, I was not at all sorry to get rid of some of the crowd, whose scrambling and running raised the dust in clouds, making it exceedingly unpleasant travelling.

Having enjoyed a rest of thirty-five minutes, during which time the tank of the engine had been filled, and the working gear oiled, we again started, and in two hours and fifty minutes came to a stop at Irlam, to fill up the tank, having taken in a few gallons at a pump on the road side about an hour before, as it appeared none of the gentlemen in charge of the train knew where to obtain water on the route, and were consequently more careful to stop at each place it could be had, instead of going, as they otherwise would have done, five or six miles at a stretch, between the watering places.

After remaining seventeen minutes, during which the tank was filled and an immense addition made to the assembled crowd, the engine again started on its journey, and continued steadily on its course, until in ascending a steep bit of a hill, the coupling which held the last waggon to the train broke, in consequence, as it appeared, of a flaw in the metal, which reduced the strength of the coupling fully two-thirds.

This occasioned some delay, as there was no spare coupling in the train; and, in consequucce, an *extempore* coupling, by means of some short chains and hooks with which the train was provided, had to be made; and, after some difficulty in getting it to keep in its place without slipping off, the train again started, and in an hour and three-quarters from the last watering place, the temptation of a pump close by the road side, and plenty of ready hands to bucket it into the tank, induced them to stop and replenish, though they were told the canal about three miles further would give any supply.

Twelve minutes having elapsed, they started again, the engine being as cool and right as possible in spite of the clouds of dust which had settled on everybody and everything, making the men look more like chimney-sweeps than decent people. This freedom from any heating was attributed to the use of a peculiar kind of grease, containing some oxides of the softer metals, which causes it to act in a similar manner to the soft metal lining of an ordinary brass, reducing the friction to a mere nothing; and I was informed it was not liable to corrode, or in any way injure the machinery: as far as I could see this seemed to be perfectly correct. The consumption of this grease over a distance of 38 miles did not much exceed ½ lb.

But, to return, all went on most favourably, the crowd, from our nearing Warrington, beginning rapidly to increase, the people racing across fields and over hedges to see the train pass; and when it stopped near the town on the bridge over a small stream to fill the tank, which it did by means of a long hose pipe attached to a pump worked by the engine, the end of which was dropped into the water, I consider there were not much less than 4,000 people present. After a delay of about a quarter of an hour, they were off again, though much incommoded by the crowd, and turning round a sharp curve, where several police joined to assist in keeping off the crowd, it turned into Marshhouse Lane, along Winwick Street, Horsemarket Street, Peter Street, and into the Fair Ground, or Cattle Market, through some as narrow and tortuous streets as can well be conceived, the easy regular manner in which the engine was steered, and the train followed after, caused noisy exclamations of delight from the lookers on, both in the windows and in the streets, and by a little after nine o'clock the engine and train were safely housed in the Cattle Market, having accomplished the distance of 18 miles, deducting stoppages, in six and a half hours.

By eight o'clock next morning, I was in the Cattle-market, and found a great crowd, which I was informed had been collecting before six o'clock, and some smiths busy fitting a new coupling. The fire was lighted, and in forty minutes steam was blowing off at 65 lbs. The great doubt seemed to be amongst the assembled crowd, as to whether the engine and train could ever get out again, the place being so narrow and inconvenient. This, however, was soon set at rest, by uncoupling the engine, turning it slightly to the left, and backing it against the train, and having detached the first three waggons from the four hinder ones it took them out of the yard a short distance up the street, making a very abrupt turn to the left; it then returned, took out the remaining four, and having had them coupled up and taken in water, it was started at ten o'clock on its journey to Liverpool, down Peter Street, turning a very sharp corner, and through the Market Gate, having been handled with as much ease and exactitude as any "whip" could "tool" his "trap" when under the most favourable circumstances.

The crowd was again immense, and after passing Bank Quay Bridge, a halt was made to allow the boiler to be adjusted so as to keep the water on a level, an operation which required half a minute, and on we went again over Sankey Bridge along the road until, at 11·20, we stopped at Bold to take in water from the brook, by means of the hose and pump before alluded to; in nineteen minutes we were off again. At twelve o'clock we took in water again at the Griffin, and took some luncheon also, and in twenty-five minutes were off again, and soon arrived at the town of Prescot. Here considerable alarm was manifested by the lookers-on as to the chance of the engine and train running away down the steep incline through the town, but I was much pleased to see the wonderful control the driver had of his train: for, on being desired to stop on the incline to show how needless their fears were, he gave three whistles, for the man on the last waggon to put on his brake, so as to keep the train from running against the engine, and it immediately came to a dead stand, to the great delight and astonishment of the lookers-on.

After standing for about five minutes, the train again started, and at three o'clock stopped at Huyton for water, having had a small quantity previously at Rainhill. In a quarter of an hour the tank was filled, and at a little past five we again stopped for water, it being considered desirable to avoid the necessity of stopping in the streets of Liverpool to take in water.

Soon after this we entered the town of Liverpool, where we were met by some police, who assisted in keeping the large crowd in order, and the train proceeded along Lime Street, in front of St. George's Hall, along Manchester Street, turning at a right angle into Dale Street, then into Moorfields, and after making two more turns at right angles, proceeded along Great Howard Street to the yard of the Lancashire and Yorkshire Railway Company, who had kindly placed it at the disposal of the Company, arriving a little after six. Here the engine and train were kept at work for a week or so, in order to enable all interested in such matters to become acquainted with it from seeing it at work.

The actual time in travelling the twenty miles, from Warrington to the yard, was 6¼ hours, all stoppages being deducted; and the coke consumed, from the time the engine left Manchester, including getting up steam, was a little under 1 ton, and the water about 50 gallons per mile. The grease used was about a quarter of pound per mile for the cycloidal irons of the shoes, and the teeth of the driving segments on the wheels of the engine, and carts; and the oil did not amount to half a gallon from the time of leaving Manchester. The fire-bars used were Gray's patent, which, with very bad coke, gave an excellent supply of steam; and when I saw them at Liverpool when the fire was pulled out, looked as fresh as though they had not been used.

It was satisfactory to observe how admirably the endless railway both on the engine and carts worked, and to find from the surveyors of the roads, who in several places on the road examined its working that it positively *improves* the roads instead of damaging them, proving the truth of your remark that road locomotion without injury to the roads is here most perfectly and efficiently attained.

In concluding, I beg to express my thanks to Mr. Young, the engineer, and Mr. Hemming, the secretary to the Company, for their politeness and readiness in answering any inquiries and facilitating my examination of the engine and train at all times during my trip, and wishing the Traction Engine and Endless Railway Company the success they deserve,

I am, yours, &c.,
An Engineer.

Liverpool, June 15, 1859.

NOTICES TO CORRESPONDENTS.

P.—You had better apply to Mr. B. Fothergill, consulting engineer, Manchester.

Mechanic (Bradford).—The variation of the compass from the true meridian is 21·40, and the dip 68·20. We are told that in 1657 it was true meridian, the needle pointing due N.

C. Cuit.—We regret we cannot do more for you in the way of advice. Our opinion is decidedly against the scheme.

E. Small (Kennington Road).—You had better call at the office with the drawing, and if we can assist you it will afford us pleasure.

R. B. (Birmingham).—We have not forgotten our promise, the vessel will be fully of the dimensions you suggest; but a month or two must elapse ere we can supply what you require.

R. N.—The experiments of Mr. John M. Rowan for 20 to 24 hours' performance are stated to give as near the result of Professor Rankine's experiment as possible, viz., a coal consumption of 1·133 of Scotch coal per indicated H.P. per hour; Rankine's was 1·018 per indicated H.P.

T. H.—Mr. A. P. How, of Mark lane, constructs an excellent apparatus for converting sea water into fresh water. Dr. Normanby, of Judd Street, New Road, and Lancaster place, Strand, has also been very successful in the application of some patent apparatus to the same purpose.

J. P. (Paris).—Mr. Robert Waddel described his improved packing for the slide-valves of marine engines in a paper read at the Institution of Mechanical Engineers on the 30th April, 1856.

C. Kleber (Atlas Works).—The Royal Agricultural Show will this year meet at Warwick on the 10th July.

R. Low.—The engines and boiler of the *Lima*, by Messrs. Randolph, Elder and Co., Glasgow, are the most successful in point of coal economy of any sea going steam ship of the same dimensions with which we are acquainted. The superheating of the steam is effected in elongated vertical steam chests placed in the lower part of the chimney, the steam being heated whilst in contact with the water, or in the same vessel, the temperature of the steam being raised from that due to the pressure at which it is generated to 400°.

C. M. (Derby).—Thanks for the lectures, received.

FIREPROOF COMPOSITIONS.

R. Johnson, R.A.—In answer to your inquiry respecting fire-proof compositions for coating wood, we have most opportunely received the following communication upon the above subject from a correspondent, "Liquid Fire," and we therefore print it entire, as being pretty much what it appears to us you require, so you may take your choice as to which composition you adopt, but we shall be glad to learn from you the result of your applications of one or either of them.

(1.) "Said to resist the ravages of fire for *five* hours, and preventing the wood from bursting into flames, and preventing the spreading of the conflagration by additional flames.

"Dissolve in cold water as much pearlash as it is capable of holding in solution, and wash or daub with all the planks, &c., after removing paper, or paint, by planing or scraping. Then diluting the same liquid with a little water, add to it such a portion of fine yellow clay as will make the mixture the same consistence as common paint; and stir into it a small quantity of flour paste, such as is used by paperhangers, to combine both the other substances more intimately together.

"Give three or four coats, similar to painted work. One coat being dry before the other is applied.

"Then put into an iron pot equal quantities of finely pulverised iron-filings, brickdust and ashes; pour over them size or glue water; set the whole near the fire, and when warm stir them well together. With this liquid composition, or size, wash over all the clay composition, and on its getting dry give it a second coat.

"Yellow clay	20	lbs.
Flour for making the paste	$1\frac{1}{2}$	„
Pearlash	1	„

will prepare a square rood of deal boards."

(2). Said to resist the ravages of fire for $1\frac{1}{2}$ hour.

"Materials employed. The 'silicate of soda' must be in the form of a thick syrup of a known degree of concentration, and is diluted with water when required for use, according to the prescription given below

"The surface of the wood should be moderately smooth, and any covering of paper, paint, or other material, should be first removed entirely by planing or scraping.

"The lime-wash should be made by slaking some good fat lime, rubbing it down with water, until perfectly smooth, and diluting it to the consistence of thick cream.

"Treatment of the Wood.

"The protective coating is produced by painting the wood; firstly, with a dilute solution of silicate of soda; secondly, with the lime-wash; and, lastly, with a somewhat stronger solution of the silicate.

"A solution of the silicate, in the proportion of one part by measure of the syrup to four parts of water, is prepared in a tub, pail, or earthen vessel, by stirring the measured proportion of the silicate; first, with a very small quantity of the necessary water until a complete mixture is produced, and then adding the remainder of the water, in successive quantities, until a perfect mixture in the requisite proportions is obtained.

"The wood is then washed over with this liquid, by means of an ordinary whitewash brush; the latter being passed two or three times over the surface, so that the wood may absorb as much of the solution as possible. When this first coating is nearly dry, the wood is painted with the lime-wash in the usual manner. A solution of the silicate, in the proportion of one part by measure of the syrup to two parts of water, is then made as above described; and a sufficient time having been allowed to elapse for the wood to become moderately dry, this liquid is applied upon the lime in the manner directed for the first coating. The preparation of the wood is then complete. If the lime coating has been applied rather too thickly, the surface of the wood may be found, when quite dry after the third coating, to give off a little lime, when rubbed with the hand. In that case it should once more be coated over with a solution of the silicate of the first-named strength."

J. V. P.—We have been favoured by the gallant officer referred to with the information for which you asked, and we cannot do better than give it in the form in which we received it from him. For the information respecting the Marquis of Stafford's steam yacht, we must refer you to the noble owner. As to the other questions respecting locomotive duty, &c., Admiral Moorsom is the best authority; we are not in a position to publish the information we possess. As to the other questions, we advise you to apply to Mr. D. K. Clark, C.E.

The following are the particulars above referred to:—

Comparison of "Bremen," with Queen's Yacht "Victoria and Albert," and "Himalaya."

	Bremen.	Victoria and Albert.	Himalaya.
θ	606	435	560
Displacement	3440	2190	3220
Indicated H.P.	3516	2406·7	2050
Speed	13·14	15·014	13·78
Speed of screw	15·568	18·73	16·29
$K = \frac{S V^s}{P}$	391·03	611·73	714·8
$K = \frac{D^{\frac{2}{3}} V^s}{P}$	147·04	237·15	278·33

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c.

Under this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.—Ed.

Transmission of Inflammable Goods by Railway.—At the Public Office at Birmingham, 14th June ult., certain commission agents of that town were fined £20 and costs, for having forwarded three packets containing carboys of oil of vitriol by the London and North-Western Railway to Liverpool, to be supplied to Rio Janeiro. The packages arrived safely at Liverpool; but while they were housed in the Company's goods sheds one of the carboys burst, and set fire to the place. The railway company felt it to be their duty to summon the consigners for this infraction of their bye-laws, in sending inflammable liquids without a notification of the fact to the company's servants. The defendants pleaded ignorance of the requirements of the law in this respect, but the Bench, in delivering judgment, said that the matter was of so much importance, and the penalty so necessary as a warning to others, that if they had possessed a discretionary power to mitigate, they should not have liked to exercise it. They therefore inflicted the full fine (£20) and costs. As regards the railway company, it was understood that the matter had been amicably arranged.

Winnowing Machines. Invalid Patent.—In a recent action (Nalden v. Clayton) tried for the alleged infringement of a patent for improvements in the manufacture of winnowing machines; the plaintiff had obtained a verdict; but, subsequently, a rule was granted to enter it for the defendant. In the Court of Queen's Bench, 27th May ult., the rule came on for argument. The machinery in question had, by order of the Court, been set up in their lordship's private room; and, by arrangement with the counsel, their lordships retired for some time to inspect the said machinery. The court decided that the rule must be made absolute, to enter the verdict for the defendant, on the ground that the plaintiff's patent was invalid.

The Loss of the Ship, "Rose of Sharon."—The Board of Trade have issued their recent judgment upon the conduct of the captain, late master of this ship (from Calcutta to London), in respect of the stranding and total loss of that vessel on the French coast, off Cape Rozel, near Cherbourg. In coming up the channel, the light on Cape Carterel was mistaken for those of the Casquets, and a course was kept which took the ship ashore. The report states that "the ship was lost by improper navigation: first, in holding on her course so long, without having an observation, or getting sight of land, there being nothing to prevent her from keeping close in with the English Coast; and, secondly, in the neglect to take repeated soundings after the ship was found to be in 19 fathoms water, when her dangerous position might have been detected; and, as the master very candidly admits, she might have been saved." The Lords Commissioners of Privy Council for Trade have directed that the certificate of service held by the captain be cancelled; and that, at the expiration of twelve months, he may go up to pass an examination for a certificate of competency.

The Burning of the "Eastern Monarch" Troop-ship.—The adjourned inquest before the Borough Coroner, on the bodies of the sufferers (seven in number) by this disaster (see Notes and Novelties in present number), returned, 7th June ult., a verdict of "Accidental death." In the course of the inquiry it had been suggested that the catastrophe might have arisen from the saltpetre on board: and the Coroner, in his address to the jury, regretted that the Council for India did not provide for the return of troops to England in ships that were not freighted with combustible materials. The official inquiry at Portsmouth, directed by the Board of Trade, before the mayor, nautical assessor, &c., was concluded, 13th June ult. The Board came to the conclusion, that in their opinion, the fire was not caused by any spontaneous combustion of the linseed or saltpetre on board: that the giving of the key of the magazine by the chief officer to the steward [one of the imputed acts of careless management of the ship adduced on the inquiry], was a dereliction of duty; and that the captain's steward had acted in defiance of all the regulations given him, in going down to the gun-room, and lighting candles in the manner described [on the inquiry], and which might have occasioned the fire. The steward was, in consequence of this opinion of the court, ordered by the mayor to be taken into custody to be tried for manslaughter.

The Hauenstein Tunnel (on the Central of Switzerland Railway).—The misunderstanding which has arisen between the Committee of Directors of this line, and Mr. Brassey, the contractor, who prefers a claim relative to a flooding which took place in the works, and a counter-claim by the Company for damages arising from the delay in completion of the same, it is now understood, will shortly come before the Federal Tribunal for adjudication, by mutual arrangement.

The London and Birmingham Flint Glass and Alkali Company is to be wound up. The ultimate decision, to this effect, was pronounced (2nd June ult.) in the Court of Chancery, on appeal by a judgment creditor from the decision of the Commissioner in Bankruptcy, in Birmingham, who had dismissed the original petition for a winding-up order.

The Smoke (from Steamers) Nuisance on the Thames.—At the Thames Police Court (30th May ult.), the master of the steam-boat *Queen*, plying between Brunswick Pier, Blackwall, and Victoria Dock, was summoned by the Superintendent of the Thames Police, for using a steam-engine and furnaces in said vessel not so constructed as to consume their own smoke. A Government engineer stated that he had inspected the furnace in October last. They had been altered since, but not effectively. He was afterwards 2 hours and 16 minutes on board the *Queen*, and during that time the smoke issued from the chimney 113 times. The smoke-consuming apparatus had been applied to the River Steamers, and the smoke-consuming apparatus of the Greenwich and Woolwich steamers had been tested, and they never smoked more than three minutes continuously, and then in diminished quantities. Mr. Drew, of the Victoria Dock Company, said that since the Government Engineer's last visit, on the 22nd March, Stevens's smoke-consuming apparatus had been applied. Mr. Selfe (the Magistrate) remarked that, from October to March, nothing was done: and the owners of the *Queen* ought to have taken warning by a former conviction. The penalty is not more than £5, or less than 40s., and costs.—The defendant was fined 40s.

The Shop-lamp Nuisance Question came for decision before the Court of Queen's Bench (30th May ult.) in the case of Gabriel and another, appellants v. the Vestry of St. James's, Westminster, respondents. This was a special case, stated by Mr. Bingham, the Police Magistrate, for the opinion of the Court. The Magistrate had fined the appellants, who are surgeon-dentists, one shilling, under the 119th Section of the Metropolitan Local Management Act, for having neglected to remove a lamp, fixed by them in front of their premises in Regent Street; and the question was, whether the lamp so erected, being a projection, was an "annoyance" within the meaning of the Statute. The Court thought the mere projection was not sufficient to make the lamp an annoyance; but that each particular case of lamps so fixed depended on its own merits, and in each of them it was for the Magistrate to determine, himself, upon the evidence, whether the act complained of was, or was not, an "annoyance." The case was, therefore, sent back for the Magistrate to amend; and to find whether this particular lamp was an annoyance otherwise than by the mere projection.

London, Brighton, and South-Eastern Railway Company against the London and South-Western Railway Company. — On the motion for decree in this appeal (Court of Chancery, 8th June ult.), the Lord Chancellor held that the three agreements entered into by the London and South-Western Railway Company and the Portsmouth Railway Company, whereby they became bound to pay £18,000 per annum for the use of their station, for passengers and traffic for 999 years, were illegal, and not sanctioned by the Railway Act—that they were colourable and deceptive agreements, and not entered into *bonâ fides*, and, therefore, null and void.

Railway Weighing Machines—Alleged Negligence.—At the recent sittings at Guildhall (Court of Exchequer, 7th June ult.), the plaintiff, a carman in the service of an engineering firm at Kingsland, brought an action against the South-Eastern Railway Company for injuries sustained by reason of the (alleged) negligence of defendants' servants at the Bishopsgate station, 25th December last. Plaintiff was in waiting to receive some goods expected to arrive there by the half-past 12 o'clock train. It being Christmas Day, there were a great number of people at the station, and on the arrival of the train the rush was so great that he was pushed against a weighing machine, the scale of which was raised about 6 in. above the ground. Plaintiff fell, and broke his knee-cap. The negligence complained of was, that the weighing-machine, which was placed in the way of the passengers, was raised 6 in. off the ground, instead of being flush with the pavement, as at other stations. The defence was, that the machine was in an open place, where every person could see and avoid it, and that the accident was caused entirely by the carelessness of the plaintiff. The question of negligence was left to the jury thus—viz., "that the Company had admitted the public to the platform in question, with a certain space occupied by the machine, which was in a position to be seen by any person passing. Had they thereby been guilty of negligence ?" The jury returned a verdict for the plaintiff, with £50 damages. The judge gave the defendants (the Company) leave to move, on the ground that there was no proof of negligence.

WATER SUPPLY.—DIVERTING WATER-COURSES.—In the House of Lords, 11th June ult. (appeals of Writs of Error), Mr. Justice Wightman delivered the unanimous answer of the learned judges to one of the questions submitted to them by the House, viz., whether the plaintiff in error (the occupier of an ancient mill on the river Wandle, could maintain an action against the Croydon Local Board of Health, whose representative, the defendant, had sunk a well, about a quarter of a mile from the river Wandle, and pumped up large quantities of water to supply the town of Croydon ; thereby sensibly affecting the flow of the river, and causing damage to the defendant who, as also all previous occupiers of the mill, had, for 60 years and more, enjoyed a right to the flow of the river that had always been supplied by water produced from the rainfalls, which sunk into the ground at various distances, and then flowed through the different strata into the river. The Court of Exchequer Chambers, in an action for damages, had held that the defendant had a right to sink a well in his own land, and to pump up the water for the use of the town. From that decision the present appeal was brought. The judges held that it was impossible to reconcile such a right as the plaintiff claimed, with the ordinary right of landowners. If such a principle were to be established, a man would not be able to properly drain his land, without being subject to actions from all the millowners on a river near him, because he might thereby alter the flow of the rain-water. They were unanimously of opinion that the decision of the court below was correct, and that the plaintiff could not maintain the right he claimed—to prevent the defendant taking the water. Lord Brougham said a more important case, or one of wider operation, he could not imagine. Further consideration postponed.

THE PORTABLE STEAM-POWER COAL-WHIPPING MACHINE, lately introduced into the trade, has already given occasion to serious differences amongst the coal-whippers and their employers. At the Thames police office three Irish coalwhippers, of Shadwell and Wapping, were charged with assaulting William Wardell, engineer, the inventor and patentee of the machine alluded to, which, it appears, does not entirely supersede manual labour, but renders the work of drawing coals from the hold of a ship, and discharging them into lighters and barges, much less arduous to the men employed. Owing to the recent strike among the coal-whippers, several persons had determined to avail themselves of the coal-whipping machines; amongst others, the manager of the Ratcliff Gas Light Company, who had one of the machines placed on board of a collier in the river. This led to the assault in question, which appears to have been a most desperate one; but the consideration of which stands adjourned by the magistrate.

WATERLOO BRIDGE.—QUESTION OF LIABILITY TO TOLL.—In the Exchequer Chamber, 18th June ult., the court, on appeal from the Judgment of the Court of Queen's Bench, decided that the tolls were liable to the claim for land-tax made by the parish of St. Clement Danes: as to the question of district, the court said it was clear that the water, to the mid-channel, belonged to whatever parish or precinct the adjoining shore belonged to. If the soil over which the water flowed had been, by a change in the river, reclaimed, it would have belonged to the adjoining land. There being nothing to exempt these tolls from the payment of the land-tax, it followed that the tolls were payable. Judgment of the Court of Queen's Bench confirmed.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

WE have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "18, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

THE NEW PATENT GRAVITY BINNACLE, invented by Mr. G. Brown, of Deptford Dockyard, is understood to have been fully and satisfactorily tested on board the transport *Diligence*, in some heavy gales encountered by that vessel on her recent passage from Deptford to Devonport.

THE BLACK RIVER WOOLLEN MILLS, WATER TOWN, NEW YORK, have been destroyed by fire, involving a loss of 40,000 dollars.

GRANITE CEMENT FOR SHIPS' BOTTOMS.—About ten months ago H. M.'s iron screw steam store-ship *Industry* was coated on either side, by way of experiment, with a solution of granite and other composition, the respective productions of Mr. Hayes and Mr. Szerelmy, as preventives to rust and corrosion. On the 30th May ult. she was, on return from Rio and Ascension, docked at Woolwich, to undergo an official survey of her hull, which has collected an unusual quantity of barnacles and sea-weed over the composition. On the 1st June ult., the Surveyor of the Navy, the Superintendent of Woolwich Dockyard, the Chief Engineer and Inspector of Machinery, the Master Shipwright of Woolwich Dockyard, &c., proceeded to a close inspection. After applying the necessary tests, and entering into the most minute examination of the new coating, the committee were of opinion that the proposed advantages had not been realised. The *Industry* has since been coated, for trial, with a composition of red lead and tar.

OPENING OF THE TEHUANTEPEC STEAMER LINE.—The steam-ship *Coatzacoalcos*, one of the vessels of this new line, arrived recently at New Orleans, with advices from Francisco to the 20th May ult. She had on board 1,700,000 dollars in treasure.

THE WESTMINSTER PALACE CLOCK was, 30th May ult., set in motion, but the hands on two of the dials only acted effectually—viz., those on the west and north sides. No hour was struck, nor were the quarters chimed. Some defect in the machinery is assigned as the reason of this merely partial completion of the works.

AMONGST THE TYNE AND WEAR SHIPWRIGHTS a strike is considered as inevitable, in consequence of the masters refusing an increase of 1s. a day wages. Some of the Tyne yards are already out. There is a great demand for North country shipwrights in the naval dockyards.

A STRIKE AMONGST THE SAWYERS OF WOOLWICH DOCKYARD occurred 27th May ult. The whole of the men (upwards of 100) employed in the Timber Inspector's department, after receiving their weekly pay, amid much grumbling and clamour, returned to their respective posts, and unanimously resolved to strike from work. Mr. Sturdee, Master Shipwright of the Yard, was appealed to by the Inspector of the department, but the men persisted in their determination to yield to no persuasion nor promises short of a redress of their grievances, the chief of which appears to be the excessively low rate to which the scale of prices has been reduced, by order of the Board of Admiralty, insomuch that their weekly receipts at task-work, from 7 o'clock a.m. to half-past 7 in the evening, including the extra allowance for the purchase and supply of saws, files, and other necessary tools, never exceeds £3 per pair of men, under the greatest exertion, the upper man, who is responsible for the supply of the tools, receiving £2, and the under man £1. Their repeated complaints and appeals for redress to the officials of the Yard on the subject bad, hitherto, been without effect. Accordingly the men abstained the whole of the afternoon in question from work, retiring at the usual hour, on the gates being thrown open.

AT PORTSMOUTH DOCKYARD also the sawyers (30th May ult.) refused to commence their work, owing to some grievances connected with the new scale of pay. The men, however, returned to their work, after receiving a communication from the authorities about 2 p.m.

A FATAL EXPLOSION [ALLEGED AS SPONTANEOUS] occurred about ½ past 1 a.m., 3rd June ult., on board the troop-ship *Eastern Monarch*, anchored at Spithead, from Kurrachee, bound to Gravesend. Passengers on board—11 officers, 3 ladies, 450 men, women, and children. Cuddy-deck blown up, bulk heads, &c., carried away, and cuddy filled with a thick sulphurous vapour. Majority of the crew saved by the boats of the *Falcon* and *Flying Fish*, men-of-war, at Spithead, when the *Eastern Monarch's* masts fell over her side, and the ship burst into a body of flame, fore and aft. Cause of disaster (supposed) to have been that a large quantity of saltpetre was stowed in the after-hold, and that spontaneous combustion must have taken place. One woman and five children killed or suffocated by the explosion; one soldier and one child otherwise lost. The vessel was of upwards of 1,500 tons register; owners, Messrs. Somes Brothers, of Blackwall: she was nearly new, this being only her second voyage to India. Her cargo consisted of saltpetre, linseed, ivory, and bones. [For result of inquest, see Legal Decisions, present number.]

THE SHIPS OF THE SQUADRON OFF PORTLAND.—REED'S NEW CODE OF SIGNALS is to be tried on board the *Royal Albert* screw steam-ship, 121, and a report will be made of the trial by Mr. Colombe, flag-lieutenant to Rear-Admiral Sir F. Pasley, who is on board the *Royal Albert* steam-ship, 121, to superintend their working. The last-named vessel was, 15th June ult., towed out of Plymouth Sound, by the steam-tugs *Zephyr* and *Confiance*, and proceeded under canvas for Portland accordingly.

OF FOREIGN CLOCKS, the total number imported into the United Kingdom, in the four months ended the 30th April, 1859, was 82,902; and of WATCHES, 34,632.

STEAM-ENGINES ON COMMON ROADS.—A deputation on this subject had, 10th June ult., an interview with the Home Secretary, at his office, Whitehall. The deputation consisted of Mr. W. J. Garnett, M.P., Mr. Henning, and Mr. McAdam.

BOAT-LOWERING APPARATUS.—Clifford's and Kynaston's compared.—At the conclusion of the last screw trial on board the *Doris*, the two systems of boat-lowering invented by Mr. Clifford and Captain Kynaston were displayed, the ship going about 6 knots. Captain Kynaston's disengaging-hooks appear to require four men for the operation, the success of which depends on the simultaneous working of the men. By Clifford's method, the whole appeared to be safely performed by one man, who, by slacking off a rope, insures the boat being lowered on an even keel.

NASMYTH'S STEAM PILE-ENGINE was used in the construction of the concave river-wall for the Tyne Docks. This machine is so contrived, that it forms its own roadway throughout: and where there is a large amount of straightforward piling, or in cases of difficult driving, it is considered without an equal.

DR. REID'S VENTILATING APPARATUS FOR SHIPS consists, essentially, of two pipes, each about 300 ft. long, and 2 ft. in diameter, which command the whole ship. These have communication with the sleeping-berths, the cabins, the hold, and every place where ventilation is required. The Russian war-steamer, *General Admiral*, lately launched at New York, is the largest ship on which this plan has been applied; but it has been adopted on several British vessels. The currents of air are produced by the aid of a "donkey engine," having a boiler of its own; this engine also drives two steam-pumps, which pump out bilge water, supply water to the main boilers of a steam-vessel, and can be made to perform efficient service in case of fire.

LIFE-BOATS FOR RUSSIA.—During the past month three new life-boats, built by the Messrs. Forrest, on Mr. Peake's plan, have been sent to the Emperor of Russia. They are to be stationed in the Gulf of Finland. A Russian Steam Packet Company have likewise purchased from the builders two life-boats of the same class, to be stationed at Odessa.

FOR THE PRUSSIAN GOVERNMENT, A LIFE-BOAT (Institution plan) has been forwarded.

COATING SHIPS' BOTTOMS.—The screw steam-ship *Himalaya*, about nine months since, received a coat of Peacock and Buchan's composition, which seems to have contributed, in a great degree, to the rapidity of her movements on her late voyage to and from the Cape of Good Hope (58 days only at sea.) Since the application of the composition, the *Himalaya* has traversed 26,000 miles; and the authorities at Keyham, where she now lies for repairs, &c., appear well satisfied with the result. Usually, with such an amount of service, a coat is given every six months. In the present case, the plates and rivet-heads continue in excellent preservation; and the bottom presents a very smooth appearance, being merely covered with a dark, thin, slimy substance. It is however, remarkable, that grass has grown on the "pressure" part of the screw, on a portion of the rudder, and those parts of the bow and water-line where the composition seems to have been rubbed off, and encouragement thus given to vegetation by the exposure of the under-coating of red lead. Red lead will not be used now, but two coats of the composition will be applied; the under one direct against the bottom.

TROTMAN'S PATENT ANCHOR.—The inventor, Mr. Trotman, has publicly complained of the treatment he has experienced from the Admiralty authorities, who, it appears, have not generally adopted his anchors; although in the case which he points out, of the Royal Yacht—"where the Admiralty dare not trifle with the safety of the Queen"—they have ordered its use. He also challenges a competition, at his own expense, of a "Trotman's" anchor of 50 cwt., costing £90, against any anchor now in her Majesty's dockyard of 100 cwt., or more, the contract value of which exceeds £365. It shall, he says, sustain a higher proof, possess greater holding power, and perform, in an efficient manner, every duty required, although only one half the weight, and one-fourth the cost of the larger anchor.

NEW MASTIC, OR CEMENT FOR JOINING STONE, &C.—Sulphur, bees' wax, and rosin, equal parts: the sulphur and rosin are to be melted together: the wax is then added, and the whole intimately mixed; the edges of the stones to be cemented together are to be gently heated; and, in that state, anointed with the mastic: then pressed tightly together, until they are quite cold. If these directions be carefully attended to, the cement is so tenacious, that the stones will sooner break off at their edges than at the cement.

THE FLOATING DERRICK.—RAISING FLOATING-CRAFT.—An opportunity of again testing the effectiveness of this machine for hoisting floating craft from the river [in addition to its applicability to the raising sunken craft] presented itself, 18th June ult., when a large vessel, named the *Foremgen*, of about 270 tons, was moored alongside the derrick. Three chains were passed under her bottom, and attached to the lifting-machinery of the derrick; and, in the course of ten minutes, she was raised completely out of the water. A small steamer of 40 tons, named the *Water Sprite*, was then fastened beneath her; and, in the course of a few minutes, both vessels swung "high in air."

A COMPETITION OF REAPING MACHINES [in France] has been announced, and will, probably, take place between the 20th and 25th of July next, on the Emperor's domain of Fouilleuse, near the Suresnes and St. Cloud Station of the Right Bank Versailles Railway. About forty French machines, it is expected, will be presented; English makers have also applied to be allowed to compete. Their request will probably be granted.

A NEW FILE-CUTTING MACHINE has recently been imported (and we believe patented in this country) from France. The file is placed upon a self-adjusting bed, capable of being turned in any direction; and the chisel, or cutting instrument, is fixed in a vertical slide, acted on by a spring, and giving about a thousand blows per minute. The machine is under the control of the workman, and occupies very little room. It is said to produce better files than can be made by hand-labour; and that it will do ten or twelve times as much work as an ordinary skilled workman. The machinery is already in operation in France and Belgium.

SHEET-METAL SAILS.—An inventor (Mr. F. Trevethick, of Penzance) has patented a curious improvement (?) in matters nautical. He constructs the sails of ships of narrow bands of thin sheet-metal.

RAILWAYS, &c.

A RAILWAY FROM GREENWICH TO WOOLWICH, by means of a branch line, about 2 miles in length, connecting the London and Greenwich with the North Kent at Charlton, and passing directly through the town of Greenwich, is at length in a fair way of realisation; the difficulties hitherto opposed to the carrying out of this project—viz., the opposition of the Commissioners of Woods and Forests and the objection of Professor Airey, the Astronomer Royal, to a railway passing close to Greenwich Park—having been removed. No further opposition, therefore, will be offered to the construction of this line, which is approved of by the South Eastern Company, and will shortly be commenced. The proposed branch will not only shorten the route from London to Woolwich, but will supersede the objectionable Blackheath Tunnel.

THE OPENING OF THE EAST SUFFOLK RAILWAY, an important undertaking, set on foot in 1855, took place 1st June ult. The new lines thus opened extend from Ipswich to Great Yarmouth, 53 miles, and include, also, branches to Lowestoft, Leiston, Framlingham, and Snaps. The total length of the new line is about 70 miles; and the expenditure has been about £1,500,000. The Eastern Counties Company has undertaken to work the system.

ON THE GREAT WESTERN OF CANADA LINE the latest official traffic returns show a comparative decrease.

FRENCH LINES—MARSEILLES TO TOULON.—The Administration have officially announced the formal opening of this line [already partially open from the 30th May ult.] At Marseilles, preparations on a grand scale are being made for the occasion.

EASTERN [OF FRANCE].—The six enormous cast-iron columns (fluted, and of the Composite Order), which are to carry the Skew-Viaduct over the Boulevard Mazas, for the Vincennes Railway, are from the Tussey Foundries. They are about 80 centimetres in diameter and 6 metres in height. They are splendid specimens of casting.

GREAT NORTHERN [OF FRANCE].—The works for the branch line, which is to connect Arras with Hazebrouck, have been commenced. This branch will shorten, considerably, the journey from Paris to Calais and Dunkerque, by avoiding the long *detour* by Douai and Lille.

WESTERN [OF FRANCE].—The Company have decided that, instead of the great work of filling up the valley of Les Eudes, in the railway-section of Pont l'Eveque to Honfleur, an iron viaduct, 120 metres in length, with four arches of 40 metres each, shall be constructed. This bridge will be 32 metres in height from the ground. Shafts, 60 metres in depth, are being sunk, to receive the foundations, which are to be cast in bêton, inclosed in iron tubes.

CENTRAL [OF SWITZERLAND.]—The recent opening of the Hauenstein tunnel has tended to brighten the prospects of this line; inasmuch as there is now a direct communication established between Bale and Berne, Lucerne, Bienne, Soleure, Berthoud, Olten, Aarau, &c. When the junction with the French lines shall have been completed, and the rest of the Swiss lines finished, the advantageous position of the Central Swiss, as intermediate between the principal railway systems of Northern and Southern Europe, will become more and more apparent.

GENEVA AND LYON.—The opening of the new station for the Geneva railway, at Brotteaux, Lyons, took place on the 1st June ult., since which, the passenger and goods traffic is carried on regularly from this spot, although the Saint Clair station has been retained for the service of the neighbouring localities.

FOR THE GREAT TUNNEL UNDER THE ALPS (MONT-CENIS, Victor Emmanuel Railway), the expenses, up to the present time, amount to 5,000,000f., for a length of 613 mètres, which have been pierced, 358 on the Piedmontese side, and 255 on that of Savoy. The cost of this extraordinary tunnel has been 3,156f. the lineal mètre—say, £120 a yard. (The French journal, "l'Industrie," states 5,700f. per mètre, nearly.)

AUSTRIAN [HUNGARIAN] LINES.—THE DEBREZIN-MISKOLCZ Railway, has been opened. There is now one continuous line of railway communication from Vienna to the farthest and most easterly parts of Hungary.

PERAMBUCO [BRAZILIAN] RAILWAY.—Report of progress, according to late advices from Brazil, highly favourable. Works on second section being pushed forward, and the workmen were through the tunnel. Number of labourers employed, 2,500; many more available if required. Plans of the whole of the third and of part of the fourth section were finished, and surveys of the latter would soon be completed.

SPANISH LINES.—FROM AGUILAR DE CAMPÓO TO VERGANO a railway is to be constructed, to develop the rich coal-beds of the valley of that name, and of the Vecilla. An influential company has been formed for this object.

FROM CACERES TO MERIDA a concession for survey of a projected new line of railway has been granted to Don Pedro de la Pedraja.

FROM PALINA TO ECIJA a similar concession for a new line has been granted to Don Mariana Bazan.

FROM ALCAZA DE SAN JUAN TO CIUDAD-REAL.—The concession of the railway has been adjudged to Don Antonio de Lara, Marquis of Villemediana, with a subvention of 15,899,243 reals vellon [96 of the latter equal £1 sterling] for all the line; or 141,369 reals 32 cents. per kilometre.

OVER THE SEVILLE AND CORDOVA LINE locomotives now circulate freely, although the inauguration day is not yet fixed.

THE CHARING CROSS RAILWAY BILL, although strongly opposed by Sir De Lacy Evans, who moved, by way of amendment to the motion for second reading, for the appointment of a Royal Commission to inquire as to all railway projects, where the termini are proposed to be established within, or in the immediate vicinity of, the metropolis, and who argued that the new terminus would be an obstruction to the traffic of the Strand—was read a third time in the Commons, 21st June ult.

ON THE TRIESTE LINE OF THE LOMBARDO-VENETIAN RAILWAY the traffic for the week ending 27th May ult. was £41,691, being £18,816 more than in corresponding week of last year.

AT CHERBOURG a branch railway from the Great Western [of France] is in progress of construction, to connect the present depôt with the old arsenal by a line of rails running along the east quay of the basin. It is to be used chiefly for the conveyance of coals.

RAILWAY ACCIDENTS:—

ON THE RAIL.—On the Bangor and Carnarvon line (31st May ult.) a fatal accident occurred to the station master at Griffith's Crossing and a woman. The latter was attempting to cross the line to meet the 4 p.m. Bangor train, when her foot slipped, and she fell across the rails. The whistle of the engine-driver (who could not stop the train) brought out the station-master, who rushed to rescue her. In an instant the train was down upon them, killing them both upon the spot.

ON THE SOUTH-WESTERN RAILWAY, same night, about half-past 6 p.m., the gate-keeper at the Ringwood station, on the Dorchester Branch, was killed from a similar cause. The express train from London was nearing the station, when the unfortunate man noticed two persons attempting to cross the line. He rushed forward, pulled one person off the line, and was in the act of going to the other, when the train knocked him down, and the wheels of the carriage passed over him.

LIGHTNING AND LOCOMOTIVES.—A fireman on the Great Northern Line was (29th May ult.) struck by lightning, while on his engine, just after he had entered the Spalding Station. He was thrown to the ground, the tender running over his hand, and crushing it so severely that it was found necessary to amputate it at the wrist. The "Lincolnshire Chronicle," in noticing this accident, ascribes it "to the dangerous effects of the electric fluid when brought into contact with a bright metal surface," alluding, probably, to the engine.

IN A TUNNEL.—A plate-layer, whilst passing (accompanied by his foreman, and carrying a load of tools, 7th June ult) down the tunnel which adjoins the joint station of the Great Western and Oxford, Worcester and Wolverhampton Railways, was run down by a Great Western goods train, and killed on the spot. Death was caused by a blow on the head from the truck, which had come in contact with deceased. The foreman escaped unhurt.

OFF THE RAIL.—A stoker on the Edinburgh and Glasgow Railway was killed, 14th June ult. The express train from Glasgow, consisting of a locomotive, six carriages and van, ran for about 30 yards off the rails, midway between Castlecary and Greenhill, while the engine inclined towards the opposite embankment down which it ran, carrying with it one first-class and two second-class carriages. The locomotive made a plunge, which rent the connecting-chains of the tender, and then the latter on its side. The stoker was thrown under the tender and crushed to death. The passengers escaped unhurt.

TO A GUARD ON THE LONDON AND SOUTH-WESTERN a fatal accident occurred on that line, 13th June ult. The Windsor goods' train had arrived, 11 o'clock p.m. at the Brentford Station. An alarm being given, the porter went back about 20 yards from the platform on the down-line, where the deceased was found lying on the "six feet," that is, between the up and down lines, with his legs smashed: he died next morning at Guy's Hospital. At the time of the accident the train was only then drawing into the station. Deceased is supposed to have been standing on the steps and to have lost his hold. It appeared that the engine had gone on after the train had stopped, and hence the accident. The jury, however, returned a verdict of "Accidental death."

RAILWAY BREAKS.—It seems now to be ascertained that break-power can be applied with greater power upon the train, and with less shock to the rails or carriages, if it is employed *continuously*—that is to say, all along the train—than if it is used only at one or two points, as is the custom at present.

THE TRAFFIC ON RAILWAYS.—In the half-year ending the 31st December, 1858, 76,529,202½ passengers were conveyed on all the railroads open in the United Kingdom—viz., 9,831,181 first-class; 22,536,911¼ second-class; 13, 370,758 third-class; and 30,799,352 parliamentarian. Total miles travelled by all passengers, 1,051,298,012½. Total receipts from passengers of all classes, £5,782,104. Tons of general merchandise conveyed, 13,002,735; of minerals, 25,602,118 tons. Number of passenger-trains run, 1,093,208; of goods'-trains, 651,614. The former trains travelled 24,304,599, and the latter, 20,443,706½ miles. Gross total receipts from all sources of traffic on all railways in the United Kingdom amounted to 12,825,826.

THE TOTAL LENGTH OF RAILWAYS authorized by the Acts of 1858 was 328¼ miles; and 45½ miles previously sanctioned, were authorized to be abandoned; leaving the increase 238¾ miles.

RAILWAY CAPITAL authorized to be raised by the Railway Acts of 1858:—amount of share-capital, £4,902,296; by loan, £1,932,409; total, £6,834,705. Increase of capital (after authorized reduction of share-capital and loans) by Acts passed in 1858, £6,052,678.

OF RAILWAY ACTS, 73 were passed in 1858—viz., for construction of works, additional rails, extension of time, powers to lease, sell, amalgamate, &c., to cross roads on the level, and other purposes.

TELEGRAPH ENGINEERING, &c.

FROM THE LAND'S END TO CANADA, a submarine cable is confidently talked of. The project, which has been for some time under consideration, embodies the laying, simultaneously, of two telegraphic cables between Cornwall and some point on the Coast of Canada; thus giving an exclusive English character to the enterprise. So sanguine are the contractors of success, from the form and structure of the cable to be employed, that they are understood to have offered to submerge it entirely at their own risk.

THE DARDANELLES—ALEXANDRIA SUBMARINE LINE.—The *Elba*, with the cable on board, was at Alexandria, on the 25th May ult., preparing to lay the line to Candia, which will complete the link between London and Aden.

THE SUBMARINE TELEGRAPH COMPANY are to take possession of their new premises, in Threadneedle Street, at the end of the present month.

THE RED SEA TELEGRAPH is in full progress. The paying out of the cable commenced at Suez; and Cosire, on the Egyptian coast—a distance of 200 miles—was the first station to which it was carried. Thence it was laid to Suakin—a further distance of 460 miles—where, according to the telegram recently received, it has been safely landed. The next stage will be from Suakin to Perim—540 miles. From Suez to Aden constitutes the first section of the undertaking. The second will be from Aden to Kurrachee, where it will be at once in connection with India. The cable for the purpose is already in course of construction. On the 8th June ult. the Company received information of the successful laying of their cable as far as Aden, on the 28 May ult. Future telegrams from India may, therefore, be expected to be accelerated about seven days.

FROM THE ISLAND OF GOTHLAND TO THE SWEDISH COAST a submarine cable has been successfully laid down.

THE MONTREAL TELEGRAPH COMPANY'S LINE [advices from St. John's to the 26th May ult.], has been completed.

THE NEW ATLANTIC TELEGRAPH CABLE is to be laid [if possible, within this year] from the Land's End in Cornwall to Blanc Sablon, an island in the Straits of Belle Isle, at one of the entrances of the Gulf of St. Lawrence, and a little to the north of Newfoundland. A short wire, to be laid by a separate company, is to take the cable from Blanc Sablon to the Island of Anticosti, to meet lines already open, communicating with Quebec, Montreal, and, indeed, all parts of Canada. Another short line from Anticosti will be submerged to Cape Breton, where it will join the network of lines which communicate with Halifax, Nova Scotia, Boston, New York, &c. The increased distance [as compared with the line of the Old Valentia Company], is but little over 150 miles; and is expected to be more than compensated for, by the increased advantages of the new [British Transatlantic Telegraph Company's] route; more especially as avoiding the steep range of submarine mountains on the West Coast of Ireland, on which the Atlantic telegraph cable was lost. The new cable is to be of light construction, with no outer covering of wire, the conductor being composed of seven copper wires coated with manifold insulators; the outer covering being of hemp. Weight less than 8 lbs. per mile: breaking-strain about 2 tons, or equal to supporting nearly 6 miles of its own weight in air, and 25 miles of its own weight in sea-water. Cost, about half that of the old Valentia cable.

Electro-Telegraphing Across Water without Wires.—The last we have heard concerning Mr. B. Lindsay's experiments on this head, is that he has, recently, telegraphed successfully across the Tay, opposite to Glencarse, where it is about half a mile broad. That the action on the needle was strong: and that the same battery-power would cross, he thought, at Broughty Ferry.

The Candia Cable, according to a telegram from Malta, dated June 7th ult., broke, and was lost, on the 1st June, 60 miles from Cape Sidero.

Between Ismail and Odessa a telegraphic line is to be established, for conveying news from Western Europe to Constantinople, without passing by Vienna.

The Atlantic Telegraph Company still shows symptoms of existence. The directors' late report informs the shareholders of the terms of their arrangement with Her Majesty's Government, namely—1st. A dividend of 8 per cent. per annum to be guaranteed for twenty-five years, upon such portion of a new capital as shall be called up and expended in establishing communication with America, not exceeding in the whole the sum of £600,000: this guarantee to commence when the cable has been successfully laid; and to subsist while it is capable of being worked at the rate of 100 words per hour; 2nd. A minimum sum of £20,000 per annum to be paid to the company for Government business during the time the new cable is capable of being efficiently worked; 3rd. The company to be allowed to expend £20,000 out of the new guaranteed capital, in attempts to make the existing cable available for business; 4th. If these attempts are successful, Government immediately to commence to pay a minimum rent of £14,000 per annum, to be increased to £20,000 per annum, as soon as the new cable is brought into successful working order; 5th. Company's existing arrangement with the U. S. Government not to be interfered with. By Art. 6 the company are to transfer to Her Majesty's Government their exclusive right of landing on the shores of Newfoundland, cables intended to connect Europe with that country.

England to Gibraltar.—The paddle steam-sloop *Firebrand*, 6, having completed her screw, and tested her new machinery (after her entire reconstruction at Deptford), left Woolwich Harbour, 1st June ult. for Greenhithe, to adjust compasses previous to her surveying cruise on the skirts of the Bay of Biscay, and thence to Gibraltar, for the purpose, as noticed in our last, of sounding and ascertaining the best line for laying down a submarine electric telegraph for Government purposes. She has on board two scientific gentlemen, who are engaged to prepare a report on the subject. On the 9th June ult. she arrived at Plymouth; and, on the 12th, left for her sounding-cruize.

An "Atmospheric Telegraph" has been invented and patented by Mr. James Macnab, applicable chiefly, it would appear, to steam and sailing ships; its object being to convey instantaneous signals from captain or pilot, to the engine-room or captain's cabin.

The Over-house Telegraph System is being extended. The London District Company have lately had workmen erecting poles and wires on the house-tops along the Kennington Road, between the Elephant and Castle and the "Horns," Kennington, forming a portion of the works contemplated by this company.

The Atlantic Telegraph Company Bill (No. 2), was (18th June ult.), read a third time and passed in the House of Commons.

The Red Sea and India Telegraph Company (No. 2) Bill was (18th June ult.), read a third time in the Commons, and passed.

Malta to Sicily.—The Mediterranean Extension Telegraph Company, authorised (21st June ult.) the raising of £15,000 in 8 per cent. preference shares to carry out a concession of a supplemental line from Malta to Sicily, in order to prevent an interruption of business on the recurrence of damage to the Malta and Cagliari Cable. [The transmission of intelligence is dependent, at present, on the integrity of the Malta, Cagliari, and Corfu line alone.] The Government guarantee (of 6 per cent.) will be in force as long as communication is open by either route. The Neapolitan Concession secures the right of submarine telegraphic communication between Malta and Sicily for thirty years; one-fourth part of the price of all through messages, to or from Malta, passing over the Neapolitan lines, and the use of the English language. Length of new Sicilian Line, about 60 miles; estimated cost is from £10,000 to £11,000. All expenses, at Sicilian end of cable, undertaken by the Neapolitan Government, who also are to put up a separate wire from the Sicilian Coast to Naples, for the exclusive use of through-messages from Malta. Soundings in no place exceed 70 or 80 fathoms.

The Repairs to the Cagliari Cable (same company; broken in December, and again in March last). were announced as still being uncompleted, notwithstanding all attempts by the directors to effect that object.

Gutta Percha as an Insulator.—In laying down the Red Sea Cable [from Suez to Suakin, 800 miles], on arriving at Cosseir some delay occurred (in establishing connexion with the company's office there) in consequence of the direct rays of the sun having injured the gutta percha, which had been exposed for several hours. The experience thus gained prevented any recurrence of such an accident throughout the remainder of the line. The line now lies unbroken from Suakin to Aden, Perim, as a station, being for the present dispensed with to allow, however, of Perim being eventually taken up as a station on the line, the cable was laid within a quarter of a mile of the island; and two coils of shore-end, each half a mile long, were dropped in 3 fathoms of water opposite the landing place. Greatest depth between Cosseir and Suakin, 450 fathoms. Cosseir was reached (the *Imperator* steaming out of Suez Roads on the 9th June ult.) in forty-eight hours, there being no accident to delay the process of paying out from Cosseir; four days continuous steaming, landed the cable at Suakin, the *Imperator* having only about 30 miles of cable left on board.

MARINE STEAM ENGINEERING, SHIPBUILDING, &c.

Steam Navies of France and England in 1859.—In a discussion in the "Corps Legislatif," on the 23rd May ult., the following (Ministerial) statement of the respective strengths of the two navies was given by M. Arman. On the 1st January, 1859, the numbers were as follow:—

	England.	France.
Total of Steamers	463	231
,, Liners	49	38
,, Frigates	34	28
,, Bomb-Ships	4	0
,, Floating Batteries	8	5
,, Large Gun-boats	26	28
,, Small ditto	162	11

The rest being corvettes and other light craft.

The new Screw-Steam Corvette, "Cadmus," of 21 guns, and 400 H.P. (nominal) having completed her coaling, from the Depôt in Saltpan Reach, and having had her compasses adjusted, has joined the Channel Squadron.

The "Edgar" new Screw Line-of-Battle Steamer, 91 guns, is completing her equipments (for immediate active service), and getting ready for the pendant.

The "Phæton," Converted Screw Steam-ship (late 50-gun frigate, in No. 1 Dry Dock, at Sheerness), which was recently cut asunder in midships, underwent, 26th May ult., the process of the afterbody being launched 34 ft. from its original position. The afterbody was supported in a launching-cradle, or slipway, on an inclined plane of 5-8ths of an inch to the foot, and it was mechanically moved, by purchases, to its intended distance, only extending 1½ in. beyond her 34 ft., as intended.

At Chatham Dockyard Two New War Steamers (in addition to the four new ones recently ordered by the Admiralty to be built at that yard) are immediately to be laid down on the first slips that become vacant. One of these vessels is to be a 91-gun line-of-battle screw-steamer, and the other a 51-gun steam-frigate. Names not yet announced.

The "Royal Frederick," 100, sailing three-decker, on the stocks, at Portsmouth, is to be reduced to a 90-gun steamer, to be fitted with the screw propeller. She has been ready for launching, as a sailing vessel, with the exception of caulking, for several years, having commenced building on the 19th August, 1841, from designs of the late Sir W. Symonds.

The Frames of the Four New Steam Vessels, recently ordered to be built at Chatham Dockyard, have been completed. They are the *Bulwark*, 91, the *Undaunted*, 51, the *Rattlesnake*, 21, and the *Reindeer*, 17, screw-steamers.

The "Rodney," 90, and "Severn," 51, in dock, at Chatham, being converted into screw-steamers, are, when completed, to be attached to the second division of the Steam Reserve at that port.

The Paddle-wheel Surveying Steamer "Bann," having had her bottom coated with composition, was taken (28th May ult.) out of dock at Devonport.

Griffith's Patent Propeller.—The *Doris*, 32, screw-frigate, made (27th May ult.) her second trial of this propeller, at the measured mile, in Stoke's Bay. The trial (with this propeller) on the 25th May ult. was made at its coarsest pitch, 32 ft. The present trial was made at its finest pitch, 26 ft. 5 in. The mean of six runs, at the measured mile, gave a speed of rather over 12½ knots. Number of revolutions of engine—maximum, 58·5; mean, 58·25; pressure of steam, 21 lbs.; vacuum, 25. Although the engines on this trial completed a revolution nearly every second of time, the amount of vibration was very small.

The "Orion," Screw Steam-ship, 91, now at Malta, is, in consequence of the defective condition of her hull, about to be sent home. Carpenters are now putting her decks into temporary repair in Malta.

The "Admiralty Screw" had, 1st June ult., another trial (in the *Doris*). The greatest speed attained by this screw had been with the "leading" corner of each blade cut off. In the present trial the opposite, or "falling" corner of each blade was cut off, the screw being restored to its usual form in every other respect. The mean of the runs (six, at the measured mile in Stoke's Bay, as before) gave an average of rather over 11¾ knots. Revolutions of engines—maximum, 50; mean 49·83; pressure of steam, 21 lbs.; vacuum, 25·5; pitch of screw, 26 ft. 5 in.; diameter of screw, 20 ft. The *Doris* concluded her series of screw trials on the 3rd June ult. She is expected to proceed to the Mediterranean.

The "Chameleon" Screw, 17 Guns, laid down about four months since, at Deptford Dockyard, is progressing rapidly, an extra number of shipwrights being employed upon her, as being one of a class of vessels most urgently required in the Royal Navy.

The "Spiteful," steam-vessel, formerly on the African Station, is being entirely reconstructed at Deptford Yard. Her timbers are found to be much decayed.

The "Mutine," Screw Steam Corvette, now building at Deptford, is in a forward state, and will be launched in a few weeks. Her armament will consist of 21 guns, and a 68-pounder swivel-gun at the bow.

The Performances of the "Himalaya" Iron-screw Troop-ship, during the past seven months, have been something extraordinary, as, during that period, she has gone over 25,452 miles of sea, conveyed 5,244 troops, brought home upwards of 2,000 tons of old stores, &c. Her trip out to the Cape, and back to England, is the shortest on record—28 days 19 hours outward, and 29 days 2 hours homeward. During this voyage, she has been fitted with Griffiths' Patent Propeller. In 1857, in making the same voyage, with the common screw, she was six days longer on her passage than on her recent trip (from the Cape, with the 45th Regiment on board) to Spithead, where she arrived 1st June ult. She is now docked at Plymouth Yard for repairs, &c. She is expected to be ready for sea about the 19th.

The "Revenge" Screw Steam-ship (91), was recently hauled under the crane, at Keyham Yard, Plymouth, to receive her boilers, &c.

The "Neptune," 91, Screw Steam-ship (two-decker, the first of the "reconstructed" three-decked sailing ships), got up steam, 17th June ult., in the steam-basin at Portsmouth; every part of her machinery worked most satisfactorily. On the 18th June ult. she steamed out of harbour to test her speed at the Stokes Bay trial-ground. Results gave a speed of 11½ knots; draft of water, forward, 19 ft. 3 in.; aft, 22 ft. 3 in., with her guns, men, stores, &c.; revolutions of engines, 62; pressure of steam, 20·5; force of wind, 2½; temperature in stoke-hole, 104 deg.; barometer, 30·25; trial considered satisfactory, but as being made at such a light draught not decisive; another trial will therefore take place when she is nearer her sea-going trim.

The Despatch Screw-steamers for the Russian Government.—The trial of the engines of these two vessels, the *Souksson* and *Killassoury*, recently constructed for the Russian Government by Messrs. Pitcher and Co., at the Northfleet Dockyard, took place, 4th June ult. They are intended as despatch vessels in the Black Sea: are exactly of the same dimensions, and have been constructed on the same lines. 137 ft. in length, and 24 ft. 4 in. in extreme breadth: depth of hold, 11 ft. 4 in.; tonnage, B.M., 269 tons. Engines of the *Souksson*, constructed on Henman's Patent Principle, viz., that of passing and returning the piston and connecting-rods through apertures in the condensers; by which means, great length of connecting-rod is obtained, with comparatively small width of engine. The whole of the air, bilge, and other pumps are contained in the condenser, and are worked from a cross-head attached to the piston-rod. Cylinders 28 in. in diameter: with a 15 in. strok. H.P. [nominally] 60: but, on the trial, made an average of 115 revolutions per minute, with a pressure of 20 lbs. on the boiler, and indicated a power of 275 horses. Engines of the *Killassoury*, constructed by Messrs. Rennie and Co., on the "trunk" principle. The three runs [at the measured mile above Greenhithe] gave an average speed, for the *Souksson*, of 10½ statute miles per hour: and, for the *Kilassovry*, of something over 9 miles per hour: in the subsequent run, to the measured mile at the Lower Hope below Gravesend, the *Souksson* beat the *Killassoury* by upwards of a mile. A second trial of speed gave results not much differing from those obtained at Greenhithe.

The "Cigar Steamer" [Winans.]—The latest we have been able to hear of this once much-talked-of affair is, that the vessel made another trip, on the 10th May ult., after being "greatly altered;" the article (otherwise favourable), in the "Baltimore Sun," closing by stating, that very great alterations are again to be made in her hull and machinery!

The "Scylla," New Steam Corvette, was put out of No. 3 dry-dock, at Sheerness (20th June ult.), after having had her feed-pipes, propeller-gear, &c., overhauled. She remains in the fitting-basin to be equipped for immediate active service.

New Gun-boats.—The following six ship-building firms have contracted with the Government for the supply of the eighteen new gun-boats:—Green (2), at £24 15s. per ton; Wigram (4), at £21 10s.: Mare (3), at £21 10s.; Russell (4), at £20 10s.; Miller, Liverpool (2), price not stated; Langley (1), at £24; Pitcher (1), at £25; and White, Cowes (1), at £25. These vessels are required for speed; therefore, they will have fine lines and light scantling, and be fitted with engines of 80 H.P. From the specifications, it would appear that they are intended to carry Armstrong's guns.

The *Edinburgh* steamship, from New York for Glasgow, has [advices from Canada to the 11th June ult.], put into St. John's, Newfoundland, with two of her compartments full of water, having been in contact with an iceberg.

A New Line of Battle steamship, the *Repulse*, to carry an armament of 91 guns, ordered to be built on the new slip recently constructed in the Woolwich Dockyard, has been laid down on the blocks.

The "Bacchante," 51, screw-frigate, is to be launched the early part of this month (July.)

The "Doris," 32, Screw Steam-frigate, made (25th May ult.), her first trial with Griffith's Patent Propeller, the trials with the Admiralty Screw having been completed. The Admiralty inspector, the inspector of machinery afloat, and Mr. Miller, of the steam factory in Portsmouth Yard, superintended the trial (at the measured ground in Stokes Bay). The vibration during this trial was much less than on the trials with the Admiralty screw.

The Order for the Engines of the New "Steam-ram," about to be constructed at Millwall, has been given, by the Admiralty, to Messrs. John Penn and Son. They are to be of 1,250 indicated H.P.: and it is expected that they will be capable of working up to nearly 6,000 H.P.; and that they will secure to this iron-plated man-of-war, a speed of 14 knots.

The Screw Steamship "St. George," 91.—The artizans employed on this vessel (Devonport Dockyard) received orders, on the 27th May ult., to work from 5 a.m. to 8 p.m.

The Inauguration of New Steam-lines from Milford Haven was celebrated (28th May ult.), by a banquet, in Milford, attended by a number of gentlemen connected with the railway aud shipping interests of South Wales and Ireland, and presided over by Mr. Lever, M.P. In the course of the after-dinner speeches it was stated that Milford Haven would, in an emergency, afford a safe anchorage for the whole of the British navy. That steamers could be there coaled at 10s. or 11s. per ton, instead of at twice that sum, at Southampton. That the last ship that sailed from the Port of Galway—(to shorten the time between which latter port and Milford was the object aimed at)—carried away 643 passengers, a number wholly unprecedented for any one steam-ship to carry for so long a distance.

Launches [of Steamers].—The *Charybdis*, 21, screw corvette, was launched at Chatham Dockyard, 1st June, her boilers having previously arrived from the factory of Messrs. Miller and Ravenhill, the contractors, had been deposited on board the *Albatross*, 12, at Chatham, until the *Charybdis* was ready to receive them. The launch took place under very favourable circumstances. The launch had been fixed to take place at the top of the flood, about half-past twelve o'clock. On this occasion there was no "hanging" on the ways, as was the case, a short time since, when the screw-frigate *Mersey*, 40 guns, obstinately refused to leave the stocks. The *Charybdis* was built under the superintendence of Mr. Laird, late master-shipwright at Chatham, and his successor, Mr. O. W. Laing, from the designs of Admiral Sir Baldwin W. Walker, Surveyor of the Navy. Her principal dimensions are:—length between perpendiculars, 200 ft.; ditto of keel for tonnage, 171 ft. $9\frac{3}{4}$ in.; extreme breadth, 40 ft. 4 in.; breadth for tonnage, 40 ft.; ditto moulded, 39 ft. 4 in.; depth of hold, 23 ft. 11 in. Burthen in tons, 1,462 21-94ths. To be fitted as a screw-steamer, and supplied with engines of 400 H.P. Armament very heavy, viz., 20 8-in. guns, each of 60 cwt., and 9 ft. in length, ranged on upper deck; and one pivot 68-pounder of 95 cwt.. and 10 ft. in length.

The "Seine" Iron Paddle-steamer, of 3,096 tons, built at Blackwall, by the Thames Iron-works and Ship-building Company, for the Royal West India Mail Company, was lately launched at Blackwall from the company's premises. She is one of the three monster steamers, viz., *Shannon*, *Seine*, and *Paramatta*, which the Royal Mail Company have just added to their fleet.

The "Shannon," sister-ship to the above, is rapidly fitting out on the Clyde.

The "Ariadne," Screw-frigate, 26 guns, was launched, 4th June ult. at Deptford Dockyard. Laid down at this yard about two years since. Her machinery by Messrs. Maudslay and Co. Her dimensions are:—length over all, 318 ft.; ditto between perpendiculars, 280 ft.; ditto of keel for tonnage, 245 ft. 8 in.; extreme breadth, 50 ft.; ditto for tonnage, 49 ft. 6 in.; ditto moulded, 48 ft. 8 in.; depth in hold, 19 ft. 4 in.; burthen in tons, 3,202.

A New First-class 51-gun Screw-frigate, to be called the *Undaunted*, is ordered to be laid down on the same slip as that from which the *Charybdis*, 21, was recently launched.

The "Melpomene," 51, new Screw Steam-frigate, at Portsmouth, hoisted the pennant, 1st June ult. Her engines are of 600 H.P. (nominal), and, on her recent trial, gave a speed of $12\frac{1}{2}$ knots.

The "Imperieuse," 51, Screw Steam-frigate, went out of Portsmouth Harbour, 29th May ult., to try her machinery. Result highly satisfactory. Is getting ready for sea.

The "Neptune," 91, Screw Steamship, completed masting (31st May ult.) in the steam-basin at Portsmouth.

The "Rodney," 90, Sailing-ship, in dock at Chatham, is being converted into a screw-steamer, and being prepared for the reception of her engines. Although this vessel has been built several years, her timbers are perfectly sound. She will make a fine screw-steamer when completed.

Steamer Casualties.—The Russian screw-corvette, which brought the members of the Imperial Family on their recent visit to Paris, was lost on going into Toulon from Marseilles. She struck upon a rock, and rapidly broke up. All hands saved.

Ten (American) Steamers have been destroyed by fire at Pittsburg, Pennsylvania, The loss is estimated at 155,000 dollars. Particulars not yet to hand.

The "Sir Henry Lawrence" Steamer, one of the recently-built Indus Flotilla Steamers, with a number of troops onboard, whilst proceeding up the mouth of the Indus, struck on a snagged, sunken rock, and settled down. No lives lost.

The Royal Steam-yacht "Victoria and Albert" arrived at Portsmouth, 6th June ult., from Antwerp, with one engine disabled, from the ship, with the Princess Royal of Prussia on board, getting ashore in entering the Scheldt.

The "Virgin" (French) Lake Steamer (advices from Panama to 27th May ult.) has been wrecked there, with Mr. Belly, Chief Engineer of the Isthmus Canal scheme, on board, who narrowly escaped drowning.

The screw steam-ship *Cressy*, 80, left Plymouth, 16th June ult., for the Mediterranean. When getting under way, and while under canvas, the palls of the windlass failed, and the anchor ran away from the bows. Some of the crew were injured.

Superheated Steam—The "Valetta" (Peninsular and Oriental Steam Navigation Company), according to the Chairman's account of her, at the recent half-yearly meeting (2nd June ult.), has attained an equal speed, with new engines of 200 H.P., as she did, previously, with engines of 400 H.P. Such results, he added, were entirely due to the new principle of superheating steam, which he called "roasting it after it was boiled."

The New Screw-steamer "Lord Panmure," built by Messrs. A. Leslie and Co., of Gateshead, for the service of the Military Store Department of Woolwich, to replace the vessel of the same name, run down at the mouth of the Channel, in December last, by the Steam Navigation Company's vessel, *Derwent*, went, for her first trial-trip, down the river from Woolwich, 1st June ult.; engines supplied by Mr. Morrison. Her average speed, with and against the tide, was $10\frac{1}{2}$ miles per hour; engines making 82 revolutions per minute; pressure on valves, 16 lb. per sq. in. Her machinery possessed all the modern improvements; nominally of 165 H.P.; producing a consumption of coal of $3\frac{3}{4}$ lb. per H.P. per hour. She had embarked 90 tons of her cargo (of 350 tons of shot) prior to this trial-trip.

The Paddle-wheel and Screw Steam-sloops, "Barracouta" and "Icaru," are completed at Sheerness. The necessary gear for fitting out these war-steamers were (3rd June ult.), dispatched from Woolwich Dockyard.

The Gun-boat "Magnet," having undergone heavy repairs in her machinery, boilers, &c., at Sheerness, has resumed her duties, as tender to the Pembroke.

The Screw-frigate "Amphion," 36, has completed her alterations and repairs at Chatham. The *Victor*, steam gun-boat, takes place in the same dock, to have her defects made good.

The "Hind," Steam Gun-boat (tender to the *Russell* 60, at Falmouth), made an experimental trip, outside Plymouth Sound, on the 3rd June ult. Her engines (of 60 H.P., by Moseley and Son) having been thoroughly repaired, boilers retubed, and bottom renewed. At the measured mile she made $8\frac{1}{2}$ knots, with 144 revolutions, at a pressure of 60 lb. She returned to Hamoaze.

The "Royal Albert," 121, screw steam-ship, is to have her defects made good in Plymouth Sound.

The "Gloire" and the "Invincible," two new 50-gun frigates, now building at Toulon [Mourillon Dockyard], are rapidly advancing towards completion. They are called *Frégâtes blindées*, from having their sides covered with iron plates.

British War-steamers [Line-of-Battle] at present [July 1859] in commission.

Names.	Guns.	H.P.	Names.	Guns.	H.P.
Marlborough	131	800	James Watt	91	600
Royal Albert	121	500	London	91	500
Conqueror	101	800	Neptune	91	500
St. Jean d'Acre	101	600	Nile	91	500
Aboukir	91	400	Orion	91	600
Agamemnon	91	600	Princess Royal	91	400
Algiers	91	600	Renown	91	600
Cæsar	91	400	Trafalgar	91	500
Edgar	91	600	Victor Emmanuel	91	600
Exmouth	91	400	Brunswick	81	400
Hannibal	91	450	Cressy	81	400
Hero	91	600	Centurion	81	400

Total 24.

The "Paramatta," Royal Mail (West India) Company's Steamship, one of the three monster-steamers just added to their fine fleet, underwent (7th June ult.) her official trial in the presence of the Government authorities, &c. She left Southampton water for the measured mile in Stokes Bay, where she made four runs with the following results:—

Runs.	Min.	Sec.	Average.	Runs.	Min.	Sec.	Average.
1	4	14	14·173	3	4	29	13·383
2	4	14	14·063	4	4	14	14·173

Being an average of 13·956, or 14 knots per hour. Revolutions, $17\frac{1}{2}$; pressure of steam, 17 lbs. to the square inch; vacuum gauge, $26\frac{1}{2}$ in. She is to run on the Company's Trunk-Line, between Southampton and the West Indies, has accommodation for 274 first-class passengers, and a proportionate number of second-class. Principal dimensions: length of main-deck, 340 ft.; ditto load-line, 330 ft.; breadth, 43 ft. 9 in.; ditto over paddles, 77 ft.; depth of hold, from floor to spar-deck, 33 ft. 6 in.; H.P. of engines, 800; builder's tonnage, 3,092; registered tonnage, 2,186; displacement of launching-line, 2,215 tons. The engines are Maudslay and Field's patent double cylinder, taken from the *Orinoco*, and fitted to the "Paramatta," with improvements. Boilers made at Company's Factory at Southampton, tubular (first proof being at double the pressure intended to be used). Feathering paddle-wheels also made at the Southampton Factory. Combined weight of the four boilers, 220 tons; paddle-wheels, 38 ft. 6 in. in diameter, over the floats; diameter to centre of pressure, 34 ft. $3\frac{1}{2}$ in. Furnaces, 24 in number. Stowage capacity in ship for 1,500 tons of coals. Designed by Mr. William Rennie. Machinery fitted by Mr. Robert Ritchie.

The Trial-trip of the Russian Steam-frigate "General Admiral," built for the Russian Government by H. Webb, of New York, took place there on the 18th June ult. Her dimensions are:—length on spar-deck, 307 ft.; breadth, 55 ft.; length over all, about 325 ft.; depth of spar-deck, 34 ft.; capacity, about 6,000 tons; pierced with 44 side-ports, and 2 stern-ports on lower deck; 30 side-ports, and 4 large ports, forward; and 4 large ports aft on spar-deck; armament to consist of 40 shell guns, of large calibre, on gun-deck; and 20 long guns, and 2 pivot-guns of largest size on spar-deck. Gun-carriages all of solid mahogany. Crew, 800 men; capacity to carry water and provisions for six months. Stowage-room in her coal-bunkers for 1,200 tons of coal; draught not over 25 ft., laden for a six months' cruize. Engines and boilers manufactured at the Novelty Iron Works, New York. Two horizontal back-engines, with 84-in. cylinders, and 45 ft. stroke; nominal H.P., 800; actual, 2,000. Propeller, Griffiths' patent; blade of brass, 19 ft. in diameter, and 31 ft. pitch, arranged in an adjustable frame, so that it can be readily lifted from the water, driven by a line of shafting 124 ft. long, and 17 in. in diameter at the journal; the "thrust," *i.e.* the force of the screw against the ship, is kept off by a "collar thrust-bearing," and a "parry roller bearing," arranged so that either can be used, and readily unshipped. The engines, proper weight, 150 tons; propeller, 12 tons; brass fixtures, 12 tons; they are supplied with Silver's Marine Governor, the object of which is to prevent "racing" in a head sea; or the sudden and swift revolution of the shaft, when the plunges of the ship raise the screw out of the water. The boilers [of which there are six, horizontal tubular], are provided with a telescopic smoke-pipe, 11 ft. in diameter, so arranged as to be hoisted or lowered at pleasure, being readily taken out of the way of the sails, or during action. The furnaces [38 in number, provided with Van Syckles' grate-bar], have 21,000 sq. ft. of fire-surface, and 700 sq. ft. of grate ditto. Fire-room floor 70 ft. long by 10 ft. wide, and well ventilated on plan of Dr. D. B. Reid, of Edinburgh. On trial the screw made 48 revolutions per minute; speed, as reported, $12\frac{1}{2}$ knots per hour; vessel easily turned in a small circle. Total cost, about 1,000,000 dols. She is to leave early in June for Cronstadt.

The Trial-trip of the Screw-steamer, "Colombo," one of the fine steam-ships of the Peninsula and Oriental Company's fleet, took place at the measured mile in Stoke's Bay, on the 15th June ult. She is about four or five years old; cut asunder (recently, at Mr. Lamb's Building Yard, Liverpool), and lengthened 42 ft. amidships, making her present length, 335 ft. over all. New boilers on Lamb and Summer's patent, and fitted with Lamb's Patent Superheating Steam Apparatus. The first run at the mile was made in 5 min. $18\frac{1}{2}$ sec.; 2nd. 4 min. 24 sec.; 3rd. 5 min. 9 sec.; 4th. 4 min. 33 sec.; mean speed, $12\frac{1}{2}$ knots per hour, being a slight increase on her former rate before alteration made. Steam-pressure, 18 lbs.; vacuum, 25 in.; revolutions, 25; draft of water, 16 ft. 11 in. forward, 19 ft. 6 in. aft; weight of coals on board, 789 tons; ditto water, 50 tons; other stores, 20 tons. Propelled by a pair of balance beam-engines (by Napier, of Glasgow), which drive a geared strew, and which revolves three times to every revolution of the engines. Fitted with two steam-winches, which are available for working the fire-pumps, disposal of cargo, weighing anchor, or overcoming a leak: but this machinery can be worked either by hand or steam.

MILITARY ENGINEERING, &c.

Coast Batteries.—Weymouth Harbour.—The Sappers and Miners belonging to the 18th company of Royal Engineers, which, recently, left head-quarters, Chatham, for Weymouth, for the purpose of throwing up batteries on the coast, have commenced erecting a seven-gun battery on a spot which commands the entrance to Weymouth harbour. The battery is what is known as a "sod-battery" of two tiers, 1 tier of two guns, and the other of five guns. When completed, it is to be armed with guns of heavy metal, for which the Armstrong gun will be substituted as soon as a sufficient number of them have been made.

Five Gun-boats on a New Model have been constructed at the dockyard of La Seyne, near Toulon. They can be taken to pieces, and again remounted. Intended, it is said, to be used against the Austrians, on the Lago Maggiore. They were shipped on board the transports *Ariégo* and *Sevres*, which sailed for Genoa on the 23rd May ult.

THE ROYAL [ENGINEERS] MILITARY ACADEMY ON WOOLWICH COMMON is to be enlarged by the erection of a couple of wings, east and west, of the present building, without delay. The Government have granted £15,000 as the stipulated cost of the carcass-walls. The new buildings are to consist of separate or single rooms, to accommodate about 100 additional cadets, 4 extra class-rooms, &c. The establishment will then be limited to 250 pupils: the cost of the new wings is calculated at £30,000.

FOULING OF THE ENFIELD RIFLE.—PROPOSED REMEDY.—A correspondent of the "Times" suggests that the greased cartridges may possibly be the cause of the fouling, after several discharges: that oil or grease, boiled with oxide of lead, forms one of the most adhesive substances known: viz., the Emplast-Plumbi of the Pharmacopœia, which is the basis of all sticking-plasters. As a substitute for the grease, it is proposed that the cartridges should be simply black-leaded.

THE USUAL (OLD) GAUGE OF BULLET for the Enfield-rifle is ·568 in diameter: bore ·577, leaving a windage of ·009, found to be amply sufficient.

THE "REGULATION" BULL'S EYE FOR ENFIELD-RIFLE PRACTICE, at 300 yards, is 8 in.

THE NEW [FRENCH] RIFLED 4-POUNDERS.—The official details of the performance of this new kind of artillery, first brought into action in the recent affair near Valenza, demonstrate the practicability and immense superiority of the new arm. The range was over 2,500 metres (2,734 yards), *i.e.*, upwards of a mile and a half. After five rounds, the fortifications (earthworks) of the Austrians were reduced to ruins. It is believed that these extraordinary effects were due mainly to the long range, and that, at short distances, the fire would have been far less destructive, as the shot would have made a clean hole.

THE ROYAL LABORATORY AND MILITARY STORE DEPARTMENT OF WOOLWICH ARSENAL having, of late, received repeated augmentations and additions; the aggregate number of Government and contractors' hands now (June, 1859) amounts to nearly 10,000 men and boys.

COLOURED SIGNAL ROCKETS.—A series of experiments has been instituted at Woolwich to test the efficiency of a new description of war-signalling, patented by Mr. Roberts, of the Laboratory works, East Greenwich. The rockets are of various colours; and the system of communication is by question and answer, between distant stations, by agents instructed in the details of the plan. For trial, high points of land have been selected—viz., at Charlton, near Woolwich, and Epping Forest, a distance of about 14 miles.

THE NEW [FRENCH] MUSKET BULLET, introduced into their service a few months since, has a pyramidically-shaped hollow at the back. This form was intended to give greater strength to resist the effect of travelling; but it has another property:—when the point of a bullet strikes a bone, the back of the bullet opens out at the angles of the pyramids and inflicts a frightful wound.

THE NEW FRENCH GUN-BOATS, *Eclair, Flamme, Flèche, Grenade, Alerte, Mutine,* and *Tirailleuse,* at Toulon, June, 1859. The first four are provided with engines of 110 H.P., and with two 50-pounder guns. The stem and bulwarks are cut down level with the deck to a point just before the foremast. At this point, a stout bulwark of oak is built across the deck, from one side to the other, and before the foremast. The bulwark is inclined backwards at a slight angle, and is to be faced with shot-proof iron plates. It is pierced with two embrasures, circular-headed and straight-sided, and through these the guns are to be fired; the bowsprit being made moveable to allow of it. The three last-mentioned gun-boats—*Alerte, Mutine,* and *Tirailleuse*—are each fitted with one gun (50-pounder), mounted on the same principle, the shield being lower—not much higher than a man's waist—and curved inwards. Their engines are 25 H.P. for each boat.

THE NEW [FRENCH] FLOATING BATTERIES are provided with an ingenious contrivance—namely, a grating outside the bulwarks, which can be let down, so as to form a kind of balcony for riflemen to stand upon. Thus, supposing the battery to be fighting her port broadside, the balcony to starboard would be let down outside the bulwarks; and the riflemen who stood upon it would be protected by the whole breadth of the vessel. They carry nine ports on a broadside, but are mounted with eighteen 50-pounders, all of which, it is said, can be fought on the same side.

THE NEW [FRENCH] RIFLED 30-POUNDERS, with hammers and locks, are bored with three grooves about 2 in. wide, and an 1-8th in. deep, making about a quarter of a turn from the breech to the muzzle, with a nearly uniform twist. They are rifled at Vincennes, where thirty, as it is said, can be turned out in a day. The projectile is cylindro-conical, with *ailletes,* or "feathers," that is to say, it is composed of a cylinder about 1½ calibre in length, which, beyond this length, terminates in a cone about 1 calibre from the base to the summit. The gun throws a 60-pound shot (English measure 66 lb.); range, 8,000 metres *bon tir;* and 10,000 metres *à toute volée,* which is equivalent to a range of 8,749 yards (5 miles, all but 51 yards), at which aim can be taken, and accuracy attained; and 10,936 metres (6 miles 376 yards), extreme elevation.

THE ORDINARY [FRENCH] 50-POUNDER GUN (for the Navy) is a near approach to the English 68-pounder solid shot gun. The length of both are about equal. The French gun throws a shot weighing 55 English pounds. The guns are stamped with their respective weights, which are, on an average, 4·766 kilos., with a variation to 8 kilos. more or less, the French 50-pounder weighs 90 cwt.—5 cwt. less than the English gun alluded to, and throws a shot weighing 13 lbs. less.

WATER SUPPLY—(METROPOLITAN AND PROVINCIAL).

MELBOURNE (AUSTRALIA).—The Corporation have voted £3,000 for this year's quota towards the erection of public baths and fountains. Arrangements have been made for erecting 24 water-taps, at the junctions of the principal streets of Melbourne.

AT BROMPTON, KENT, a drinking fountain, named the Victoria, has been opened, by Lady, wife of Sir Frederick Smith. Shape—a bronze pillar, with two galvanised ladles. The water is supplied (free) from the mains of the Brompton and Gillingham Waterworks Company. The wates issues from a Lion's mouth, when a small copper ball on the top of the fountain is slightly pressed.

AT WARWICK, Coventry, Barnstaple, Sheffield, Penrith, Whitehaven, and other places, public drinking fountains have been, or are about to be, erected.

IN SPAIN, surveys are being completed (Don Juan Baptista Peyronet, concessionaire) for a canal of irrigation, to supply water for the use of the districts of Elche, Crevillente, Elda, Novelda, San Vincente, and others of the Province of Alicante.

THE WORKS FOR THE AMELIORATION OF THE RIVER SEINE (for which, about three years since, a credit of seven millions was opened, four millions and a half of which have already been spent), are being pushed forward. The plans and projects for the weirs and locks to be constructed in the upper portion of the river, "Seine Supérieure," are the work of M. Chanoine, Engineer-in-Chief of the Ponts et Chaussées.

PAVEMENT CLEANSING.—In the New Louvre (Paris) a novel and highly-ingenious expedient has been recently adopted. A number of handsome bronze pillars support the lamps for illuminating the Place Napoleon III. Each of these lamps, standing near the edge of the footway, is furnished with a Dolphin's head at its base, out of which a stream of water gushes when the gutters and pavements require cleansing.

PUBLIC DRINKING FOUNTAINS IN THE PARKS.—At a Vestry Meeting of St. Martin's-in-the-Fields, held 27th May ult., a resolution was adopted to memorialise the Government to erect drinking fountains in all the London parks. In St. James's and the Green Parks the water could be at once obtained from the pipes which pass along from the Artesian well in Orange-street, the water being the purest in London.

ON BLACKHEATH a drinking-fountain has been erected by Lord Haddo, near Chesterfield's walk.

DUMBARTON WATERWORKS.—The ceremony of cutting the first sod of these works was recently performed by the Local Water Commissioners, near a spring at the base of the Long Crags. The main reservoir is to be formed on the lands of Garslake, and will cover 5½ acres, at a depth varying from 15 to about 25 ft. It is calculated it will contain 19,000,000 gallons, which, in a population of 10,000, will yield 19 gallons per day to every inhabitant for 100 days. A filter and distributing tank will also be constructed at about 220 ft. above the level of the street: which will make the pressure of the water in the main pipe upwards of 100 lbs. to the square inch.

THE WIRRAL WATER-BILL was (18th June ult.), read a third time in the Commons, and passed.

A "CARBON WATER-FILTER" has been recently patented and introduced in various forms. The principle of the invention consists of a ball of moulded carbon, into which a tube is fixed: and the water is filtered through this ball and tube, either into a separate vessel below the filter, into the lower portion of the filter itself; or, as in the pocket-filter, into the mouth, direct by suction. The tube, in this last case, is elastic; but, in general, it is of glass.

IN GOLDEN LANE, ST. LUKE'S, a drinking fountain was inaugurated, 21st June ult. The New River Company, by contract, are to supply the water: which, with the cost of keeping the fountain in repair, will cost, as estimated, from £5 to £6 per year.

AT THE NEW FOUNTAIN IN GILTSPUR STREET, on the 18th June ult., between the hours of 5 in the morning and 9 in the evening—a period of 16 hours—7,040 persons were counted as using the water.

GAS ENGINEERING—(HOME AND FOREIGN).

GREAT [CITY] CENTRAL GAS COMPANY.—At the recent meeting of the City Commissioners of Sewers, the Medical Officer of Health presented his quarterly report of the illuminating power and chemical quality of the gas supplied to the city by this Company; by which it appears that, on an average of 244 experiments made during the quarter, the illuminating power was equal to that of 13·66 wax candles, or 11·95 sperm of standard quality. This is nearly 14 per cent. above the requirements of the Act of Parliament. The chemical quality of the gas had also been good, in regard of a complete absence of sulphuretted hydrogen, and the presence of traces only of ammonia.

GAS IN MARSEILLES.—In 1857, the consumption of gas in Marseilles (supplied by the Company of the Caisse Générale) amounted to 3 millions of metres cubes; in 1858, to 3,600,000 metres cube; and in 1859, it is estimated to reach 4,500,000 metres cube: thus showing a constant and considerable increase.

GAS IN CALCUTTA.—The number of public lights has increased from 191, in December, 1857, to 197, in February, 1859; and the private lights from 667 to 1,248. Gas is used, however, in 17 native houses only.

FORT WILLIAM is to be lighted with gas. Estimates have been requested by the Government from the Oriental Gas Company, for lighting the fort, with its barracks, church, and offices. It is also proposed to introduce gas into several other public buildings and churches in the Presidency.

THE METROPOLIS GAS AND METER QUESTION came (4th June ult.) before the Marylebone Representative Council, on occasion of a motion by Dr. Bachhoffner, that a sum not exceeding £100 be appropriated for the purchase of an apparatus which would test the quantity, quality and illuminating power of the gas supplied by the Gas Company throughout this parish.

LIGHTING PUBLIC GALLERIES WITH GAS.—An authoritative investigation into the whole of this question is in progress; the Lord-President of the Council having recently named a Commission of Inquiry, consisting of Professors Faraday, Hoffman, and Tyndall, with Mr. Redgrave, R.A., and Capt. Fowke, R.E., who will commence their investigation immediately.

AT DUNGARVON AND CARRICK-ON-SHANNON [IRELAND] NEW GAS WORKS, are to be erected. Lighting by gas has greatly extended of late years in Ireland; and there are now very few towns of any importance without it. Gas has been likewise very extensively introduced into country residences; the necessary works being erected by two Dublin gas-engineering firms, Messrs. Edmundson and Co., and Mr. Daniels, respectively.

THE INTRODUCTION OF GAS INTO HONG KONG is one of the scientific progresses of the day seriously in contemplation. A proposition to that effect has been made to the local government by an American Company, which has already introduced gas to Mauritius and the Havanah. This proposal, says the "China Mail," will require to be sent home before an answer can be given.

AN EXPLOSION OF GAS occurred at St. Paul's Cathedral, 4th June ult. A solid timber bench, used by the carpenters, was shattered to pieces; and a kind of shield for the index of the meter was broken into match-wood.

THE EUROPEAN GAS COMPANY have recently adopted a resolution, authorising the registration of the company with limited liability, and the division of their £20 shares into shares of £10 each.

METROPOLITAN GAS LIGHTING.—The Report of the Select Committee on gas-lighting in the metropolis, issued 18th June ult., is voluminous as regards appendices, tables, &c., &c., but the report proper consists of but comparatively, a few lines. For street-lighting the price for each public light per annum, varies in different parishes, ranging from 65 to 135 shillings: a difference which is explained by tables showing that some lamp-posts belong to the vestry, and some to the companies. The number of hours, per annum, during which the lamps are burning, in all town parishes, is 4,084: less in the country and suburban ones. The number of cubic feet, per hour, burnt, is, in most cases, 5; and less, in some instances.

THE LONDON (CITY) GAS-BILL, although opposed by Alderman Cubitt, on behalf of the Commissioners of Sewers, of the City, on the ground that the works would be injurious to the public was, 21st June ult., read a second time in the Commons.

THE KINGSTON-UPON-THAMES GAS BILL was (18th June ult.), read a third time in the Commons and passed.

HARBOURS, DOCKS, CANALS, &c.

THE NORTHFLEET DOCKS' plan has met with the support of the town of Gravesend, where a public meeting, convened by the mayor, and held, 25th May ult., at the Town Hall, unanimously adopted a resolution favorable for the proposed undertaking. A Government inspection of the intended site took place, recently, in consequence of a proposal made by the directors to construct temporary barracks, and afford every facility for the embarkation and landing of troops, by an arrangement with the War Department.

THE TYNE DOCKS, at South Shields, have been constructed (on the banks of the river Tyne) at the upper end of South Shields, on a large area, called Jarrow Slake, which is covered with water at spring tides, to a depth of from 5 to 8 ft. The area, so covered, amounts to about 350 acres, of which quantity 179 acres are now enclosed. The area of water in the dock, is 50 acres; depth of water 24 ft. 6 in. at an average spring-tide. Entrance-basin 9½ acres in extent; with a depth of water of 25 ft., for a width of 200 ft. in the centre of the channel, gradually shoaling to the sides. One of the entrances 80 ft. wide; one lock 300 ft. in length, and 100 ft. in width, with gates 60 ft. in width: the cills, in each case, were laid 24 ft. 6 in. below high-water of average spring-tides—such spring-tides having a lift of 14 ft. 6 in. Total quantity of EXCAVATION in the docks, was 1,783,452 cubic yards: and, in forming the standage ground, 281,305 cubic yards. Total masonry, of all descriptions, was 2,900,000 cubic ft. Cost, up to date of opening for public traffic, £440,476, including all the standage and railway approaches, shipping-jetties, purchase of land, and all the dock-works. Resident engineer, Mr. Robert Hodgson; contractor, Mr. James Gow.

GREENOCK GRAVING DOCK (Messrs. Scott and Sons) is to be increased in depth 2 ft. 8 in., and to be widened to the extent of 45 ft. There is also an addition to be made to the length; so that, when completed, it will have an available length of 330 ft. Contractor, Mr. William Yorke, of Glasgow. Superintendents of the Works, Messrs. Bell and Miller, civil engineers, Glasgow; the same gentlemen who successfully executed the extensive dock of Messrs. Todd and Macgregor, Meadowside, Glasgow.

Dock-gates.—Those of the recently constructed Tyne Docks (South Shields), are generally on the same plan as those of the Victoria (London) Docks. The only difference is, that the former are curved, both in plan and in section, the pivot of the keel-post being raised 3 ft. 6 in. above the level of the cill. There is thus less danger of anything lodging behind the keel-post; and the invert of the lock is carried right through from the end of the pointing cill. One of the advantages in the use of wrought iron for dock-gates is, that from their flotation, the weight on the rollers may be adjusted at pleasure.

Brass for Dock-sluices.—The sluices for the above are all made to work with brass against brass; and, as also the dock-gates, they are arranged to be worked either by hand or by hydraulic power; the machinery for the purpose having been furnished by Sir W. G. Armstrong and Co.

The Commercial Docks Company declared, 10th June ult., a half-yearly dividend of £2 10s. per cent.

The Kustendjie Harbour Company [Danube and Black Sea Railway], have made a call of £10 per share for the 1st August next.

The Suez Canal (according to the "Presse Egyptienne," published at Alexandria) is in full progress; the preliminary works for cutting through the Isthmus have been commenced, and the engineering operations are proceeding with great activity.

The Crinan Canal is in progress of restoration to its former state of efficiency as a useful aqueduct. Labourers, well acquainted with canal operations, being already at work at the west end of the summit-level, and also at the large fountains, among the hills. Workmen are also being employed to repair the track-boats damaged by the late accident.

The New [Coal] Docks at Swansea are expected to be opened some time in the present July, when much better accommodation for vessels will be provided than heretofore.

The Nicaragua Lake Canal, for the junction of the two oceans, is favourably progressing, according, at least, to the very flattering report of that undertaking, given by Colonel Morse Cooper, who had gone to organise the works in question for the Parisian Company, of Belly and Co., and who has recently returned, by the West Indian Mail, to Paris with a flaming account of his mission, and his success hitherto. The French engineers (English advices from Panama, to 27th May ult.) are now levelling the river San Juan, and the land between Virgin Bay and Salanas.

A Ship Canal to Unite the Atlantic with the Mediterranean is in contemplation. At one end of this navigable canal will be the Bay of Biscay; and at the other, the Bay of Alfaques.

Toulon Dockyard.—All the materials, &c., for naval construction have been transferred to Mourillon, on the other side of the harbour, where there are five covered building-slips. There are, at present on the stocks here, two liners, all but finished; the *Massena*, of 100 guns and 800 H.P., and of which 22-24ths are completed; and her sister-ship, the *Castiglione*, of which 18-24ths are completed. The timber is stored in sheds, about 1,500 ft. long, and every precaution is taken to prevent the recurrence of the disastrous accident by which, in 1840, Mourillon had its stores of shipbuilding timber (valued at upwards of £800,000) destroyed by fire.

The Suez Canal.—A supplement to the *Progresso di'Egitto*, published on the 10th June ult. at Alexandria, contains a circular, addressed by Scheriff Pasha, the Egyptian Minister for Foreign Affairs, to all the Consuls-General, declares that all the works going forward for the cutting of the canal, are considered by him to be in violation of the former express stipulation of the Egyptian Government, whereby the previous authorisation of the Port is requisite for the commencement of the works; the Foreign Consuls are therefore requested to warn such of their countrymen as may be engaged upon them to desist forthwith, and not to force the Egyptian Government to resort to direct measures of interference.

The Portsmouth New Dock Bill was, 22nd June ult., read a third time in the Commons, and passed.

The Gateshead Quay Bill was (18th June ult.), read a third time in the Commons, and passed.

The Tyne Improvement Bill was (18th June ult.), read a third time in the Commons, and passed.

The Sunderland Docks [and Wear Navigation] Bill was (18th June ult.), read a third time in the Commons, and passed.

LIGHTHOUSES.

The New Revolving Light on Cape San Blas, in the Gulf of Mexico, Florida. The United States Lighthouse Board has given notice to the Hydrographic Office, Admiralty, London, of the complete (and opening from the 1st May, 1859) of this new lighthouse. The new light is a revolving white light, showing every 1½ minute, placed at an elevation of 96 ft. above the level of the sea, and, in ordinary weather, visible from a distance of 16 miles. The illuminating apparatus is dioptric, by a Fresnel lens of the third order. The light-tower is of brick, coloured white, with a small building of two stories, attached to the eastern side. It stands in lat. 29 deg. 41 min. 41 sec. N. long. 85 deg. 24 min. 34 sec. W. of Greenwich, according to the United States Coast Survey.

The New Beacon-Light at Corpus Christi, on the Coast of Texas.—The light is a fixed white one, placed at an elevation of 77 ft. above the sea, and visible in clear weather at 14 miles. The illuminating apparatus is by a Fresnal lens, of the fifth order. The lantern is on the keeper's dwelling, which is built of brick, and coloured white. The building stands at the north end of Corpus Christi bluff. It affects the following Admiralty charts:—West Indies, Outline No. 390; General Sheet 4, No. 392 d; Florida, west coast, No. 524; also United States Lights List, for July, 1858, Nos. 327, 377; West Indies Lights List, for January, 1859, Nos. 74, 125.

The New Bell Buoy, on the English Bank, South Atlantic, Rio de la Plata. This buoy, placed in the entrance of the River Plata, is of iron, in the shape of a vessel 30 ft. long, 12 ft. in beam, and 4¼ ft. high; with a network of chain and strong wire round its deck. The bell is from about 250 to 300 lbs. weight, and is rung by the motion of the sea: moored in 3 fathoms, on the eastern side of the bank, at 1½ mile from the breakers, and lies in latitude 85 deg. 16 min. S. long., 55 deg. 51 min. 20 sec. west of Greenwich; with the Cerro of Monte Video, N.W. ½ W., and the Pan de Azucar, N.E. ½ N. The bearings are, magnetic-variation, 9¾ deg. E. in 1858. Affects the following Admiralty charts:—Rio de La Plata, No. 2,514; South American, East Coast, Sheet 7, No. 2,522.

The new [intended] Lighthouse on the Great Basses Reef of Ceylon has not, owing to various unexplained circumstances, yet been established, and the construction of the necessary erection has been deferred. It is, indeed, announced (officially) as probable, that the intended site will be changed, and that a light-ship may, instead, be moored close to the reef.

The New Light on Andros Island [Mediterranean Archipelago], one of the Western Isles of the Archipelago or Ægean Sea, stands upon a bluff point called Cape Fassa, at the north-west extremity of the island. This light-tower is about 70 ft. in height: lat. 37 deg. 57 min. 30 sec. N.; long. 24 deg. 42 min. 30 sec. E. of Greenwich, nearly. The light is a fixed light, varied by a flash every three minutes, and is intended as a guide to the Doro Channel. Elevation, 708 ft., English, above the level of the sea; visible in clear weather at 30 miles. Illuminating apparatus, dioptric, or by lenses, and of the first order. Affects the following Admiralty charts:—Mediterranean General, No. 2,158; Archipelago General, No. 1,650; Archipelago Sheet 1, No. 1,651; Sheet 2, No. 1,652; Sheet 5, No. 1,655; Andros Island, No. 1,820; also Mediterranean Lights Lists for August, 1858, No. 220; and for May, 1859, No. 236.

BRIDGES, VIADUCTS, &c.

Waterloo Bridge.—The tolls for the half-year ending the 23rd February last were £9,787 12s. 9d. against (for corresponding period) in preceding year £9,638 5s. 6d., showing an increase of £149 7s. 3d. Horse traffic for 1859, £4,744 7s. 9d., against, for 1858, £4,567 5s. 8d., being an increase of £177 2s. 1d. Foot traffic, for 1859, £5,043 5s.; for 1858, £5,070 19s. 10d., being a decrease of £27 14s. 10d., which, deducted from the increase in horse traffic, gives a general increase of £149 7s. 3d.

The Victoria Bridge, Pimlico, is in full progress. The laying of the foundation-stone of this, the first railway bridge over the Thames, within the metropolis, is announced to take place shortly. The completion is expected during the summer of 1860; the super-structure will consist of four arches, each of 175 ft. span, formed entirely of wrought-iron. Piers and abutments founded on the London clay at a sufficient depth, as it is anticipated, to withstand the injury arising from the future deepening of the bed of the river by scouring or otherwise, which has been so destructive to old Westminster and Blackfriars bridges. They are to be of massive Ashlar work. Total cost of the bridge under £100,000, and it is per contract, to be completed in less than two years from its commencement. Forms part of the Victoria Station and Pimlico Railway across the Thames, accessible to the Brighton, East Kent, Great Western, and North Western Railways.

The Fall of a Railway Bridge at Ebbw Vale Ironworks, Monmouthshire, by which catastrophe two men were killed and other mischief caused, has created a painful sensation in the vicinity. On the 11th June ult., as a number of trains containing iron-ore were passing over the Railway Bridge connected with the works, it suddenly gave way, and precipitated men, horses, and trains into the road below, a distance of about 30 ft. On the inquest a verdict of "Accidental death," was returned.

The Victoria Bridge, Canada.—The Canadian legislature, by a loyal address, have invited her Britannic Majesty to be present "at the completion" (and opening) in the year 1860, of the Victoria Bridge, the most gigantic work of modern days." The invitation is signed N. F. Belleau, Speaker, L.C., in the name of the Legislative Council and Legislative Assembly of Canada, in Provincial Parliament assembled, 4th May, 1859.

The New "Arcaded Bridge-Viaduct" [*pont-viaduc arcadé*] across the Boulevard Mazas for the Vincennes railway, extending from the Passage des Quinze-vingts, near the Place de la Bastille to the Rue de Rambouillet, Faubourg Sant Antoine, has a peculiar novelty in its construction: namely that, throughout its whole length, the upright supports of its 80 or 100 arches, are pierced with small arcades, about the width of the portes-cochères of hotels, so as to allow of a covered promenade gallery from end to end of the viaduct; and, above which, the locomotives will be constantly passing with the trains. The works are being rapidly carried on, and their termination is confidently expected by the 15th August next.

The Culoz Bridge over the Rhone, for the Lyon and Geneva line, consists of five traverse beams in iron trellis-work, supported by piers in masonry-work, lined, externally, with cast-iron. The construction of the side-walls, two kilometres in length, for guiding the flow of water through the bridge, and giving a safe direction to the rapid current, were found perfectly to resist the effects of last year's rise in the stream.

The Bridge over the Sesia, blown up (partially) by the Austrians, on their retreat from Vercelli, is a magnificent work, forming part of the railway from Turin to Novara; it is built of hard grey granite. Late advices now state that only two of the arches have been destroyed by the explosion.

BOILER EXPLOSIONS.

A Fatal Boiler Explosion occurred, recently, at the Dowlais (Old) Iron Works, Glamorganshire, by which two men (in charge of the boiler at the time) were killed. Cause of explosion, consequently, merely conjectural. At the inquest, held 9th June ult., a verdict of "Accidental death" was returned.

MINES, METALLURGY, &c.

Mining, Metallurgy, &c. in France.—The Company of the "Caisse Génerale des Chemins de Fer" have amongst other undertakings requiring considerable outlay of capital, established the coal mines of Portes, and the smelting furnaces of Saint Louis.

The Coal Mines of Portes, formerly neglected, are now the most productive of the Bassin du Gard. They produce, annually, 25,000 tons of coal; a railway connects these mines with the Mediterranean line. In 1855, the price of coal at Marseilles was upwards of 30 fr. per ton.

The Smelting Furnaces [Hauts-Fournaux] of Saint Louis.—In immediate connection by railway with the great Mediterranean port of Marseilles, this metallurgical establishment, drawing its supply of coal from the neighbouring mines of Portes, and its ore from Tuscany, Elba, Spain, and Africa, has been recently completed. In 1855, the price of pigs, in port, was from 180 to 200 fr. per ton; and of castings from 300 to 350 fr. per ton. At the new works, castings can be now produced at from 80 to 90 fr. per ton. The completion of the Portes railway, and the branch of La Joliette, will, it is confidently expected, have the effect of enhancing these local advantages, should the recent depression of the metal trade in France be replaced by a healthier state of the markets.

French Coal Mines.—In consequence of the difficulty of obtaining English coal, the French Government has contracted with the Company of La Loire for the delivery of 100,000 tons; with the Company of the Bassins de la Loire, of 150,000 tons; and with the Company of the Grand Combes, of 50,000 tons.

Mining in New Zealand.—The formation of an "Auckland Coal and Mining Company," with a capital of £8,000 (subject to an increase of £20,000, for working the coal fields recently discovered at Drury, is announced in the New Zealand advices by the Australian mail.

Consumption and Supply of Coal in France.—According to a recent article in the "Constitutionnel," the total consumption of France, in 1857, was 115 millions of metrical quintals (22½ lbs. each.) Out of that quantity, France produced 64 millions, and the import from abroad was 51 millions: viz., about 30 millions from Belgium, 7 from Germany, and 14 millions from England. The greater part of the German coal comes from the basin of Saarbruck, which is worked by the Prussian Government. For the avowed purpose of providing against the possible interruption of coal supply, as regards Germany and England, the department of marine has entered into negotiations with the French mining companies (?) for the supply of coal.

Coal-mining Statistics.—According to the calculations, recently published, of M. de Carmal, a Prussian mining engineer, the quantity of coal raised throughout the world, in 1857, amounted to 125 millions of tons, worth 930 millions of francs. Prussia, alone, contains enough to suffice for the consumption of the globe for 9 centuries. England ditto for 4,000 years.

For Coating Iron with Brass (Tytherleigh's recently patented process), the latter is applied to the iron in a molten state, and insinuates itself into the pores of the iron, thus becoming incorporated with it. Tacks, nails, hinges, and screws have been so coated, and their consequent protection is described as being perfect. Iron-wire and sheets of iron have also been coated with brass: the former after being drawn, and the latter after being rolled, and they present quite the appearance of solid brass.

Iron Trade at Wolverhampton.—Some of the large foundries are short of orders; and in small castings there is little business doing. Of Staffordshire iron there is an acknowledged bareness of stores of all kinds, both for home and abroad. Consumption of merchant-iron, at home, as regards orders, sparing. Finished iron for the manufacturing trades, consumption more brisk, even when all else is slack; a circumstance which is considered as somewhat remarkable.

Puddled Steel.—By an improved furnace [Spence, of Liverpool, patentee] "puddled" steel is manufactured without using any cinder or oxyd, to assist in decarbonising the pig-metal. It is so constructed and arranged that a sufficient supply of oxygen is permitted to enter the surface, so as to reduce the carbon of the metal to the exact proportion: then it is shut off, and the heat maintained (so as to purify the metal) for some time afterwards, before the process is completed.

The New Armstrong Gun Factory, at Elswick Engine-works, Newcastle-on-Tyne, is nearly completed. It will consist of five distinct buildings, or "shops." The largest is already finished: the rest are in a forward state. The first shop, 312 ft. in length, devoted to blacksmith's work, is to be fitted with enormous furnaces and forge apparatus, for welding the coils, of which the body of the gun is composed. It is for this shop that the recently cast anvil-block, weighing 21½ tons, is destined. Two of the shops are for manufacturing the machinery in connection with the mechanical portions of the gun: one for making shot and shell, and the fourth is for a "fitting-shop." The work of casting has already begun, and about a fortnight since, a 70-pounder was turned out.

A Terrible Blast-furnace Explosion occurred (Sunday afternoon, 5 p.m., 22nd May ult.), at Earl Granville's Old Blast-furnace, Etruria Road, Hanley. While the men were casting from one of the furnaces, the engine which supplied the hot air for blasting, stopped, and either the valve was neglected to be turned, to shut off the hot-air into the receiver, or the valve was out of order, and would not act. The foul gas and sulphur which had accumulated in the furnace, passed through the pipes, the valve, and into the receiver, and, being heated by the pipes, it caused the receiver to explode with terrific effect, shattering it and part of the engine to atoms, hurling some of the fragments to the middle of the old Race-course, several hundred yards off. The building in which the engine and receiver stood, a three-storied one, and strongly built, was shaken to its foundations, and the roof raised 2 ft., whence it dropped to its former position. The floors and ceilings were torn to shreds; walls split on each side; windows shattered to atoms; the whole of the building and machinery rendered for a time useless. The explosion was heard at a distance of 2 or 3 miles. Fortunately, although some 60 men were at work at the time in the casting-house, no personal injury was sustained. The pecuniary loss is estimated at £10,000.

New Metallic Alloys, for various purposes in the industrial arts, have recently been announced on the continent. Of these, we select the following as in most common demand:—

An Alloy of Zinc, Tin, and Lead, in the proportions following, viz.:—1° tin, 16; zinc, 4; lead, 4 parts: or 2° tin, 16; zinc, 3; lead, 3 parts,—is found to possess peculiar properties, and its use will probably supersede that of other alloys, hitherto much in use, under the names of Poten, White-metal, Britannia-metal, German-metal, &c. It may be laminated or turned in the lathe with great facility. In preparing this alloy, the zinc is melted at the lowest possible heat; the tin is then to be added, and lastly the lead. The whole is to be stirred with a wooden (green-wood) rod, so as to obtain by the ebullition that ensues, an intimate mixture, free from oxydisation, which, by the way, may be entirely avoided by covering with borax with a slight addition of rosin. The operation should be performed as rapidly as possible, carefully avoiding any violent or sudden increase of temperature. The proportions may be varied according to the qualities required; a stronger proportion of zinc imparting stiffness, and of tin greater softness and purity of colour. These alloys are very fusible, and may be soldered with ease. They are less liable to tarnish than the ordinary white metals, and are much more economical.

The New Alloys of Rhodium, Iridium and Ruthenium with Platinum, (by M. H. Desmoutis), for chemical and philosophical apparatus, jewellery, dentistry, surgical instruments, &c., appear to offer great promise of utility in these various branches. The metals in question, after being purified by the usual chemical treatment, and reduced to a pulverulent state, are one, more, or all of them, according to their destined use, mixed up with the platinum (likewise in fine powder), and the whole, intimately mixed, is brought to a state of aggregation into lumps or lingots, and then solidified by means of heat, in the manner usually adopted in the treatment of platinum. The proportions of these alloys are, it may be said, infinite in variety, according to the application intended.

American Steel.—The Damascus Steel Company have erected large works at Port Richmond, Staten Island, for making steel by Neville's patent. They are now in successful operation, making about 4 tons per day. They take the iron-ore and convert it by one continued process into puddle-iron, when it is rolled into strips, and has but to be cut into pieces and heated with fine carbon, some manganese and a cyanide, in crucibles, when it comes out cast steel of a very uniform and excellent quality, suitable for many purposes for which English steel has hitherto been imported into America and used. The manufacture of "puddled steel" has also been commenced by the American Company of the Troy (N. Y.) Works, who are stated to produce metal of a superior quality.

The Tin and Copper Trade.—From a return made to the House of Commons it appears that 78,641 tons of Copper ore were imported into the United Kingdom, last year, and 24,787 tons of British copper (exclusive of ore) exported. The imports of Tin, last year, amounted to 2,955 tons of tin, and 628 tons of ore and regulus. Of British tin, 2,327 tons were exported; of Zinc and Spelter 23,725 tons were imported; of calamine-stone, or carbonate of zinc, 2,012 tons, and of the oxide 533 tons: whilst of British zinc, 3,985 tons were exported. The imports of Lead were 14,139 tons of pig and sheet-lead, and 2,316 of ore. Exports were 352 tons of ore, 17,645 of rolled and pig lead, 1,910 of shot, 490 of litharge, 2,292 of red-lead, and 2,684 of white (or carbonate of) lead.

The Price of Tin was, 11th June ult., reduced 4s. per cwt.; making common block, 125s. 6d.; refined ditto, 133s. 6d. per cwt.

Mines in the Dominican Republic [S. America.]—The French consul has purchased the whole resources of this Republic, in the shape of mines, &c., with the sole privilege of working and digging on all the lands and islands belonging to it.

APPLIED CHEMISTRY.

Fire (for Steam-engines, Locomotives, &c.) from Water.—The Paris "Messager" announces a curious contrivance by M. Meudt, for the decomposition of water, and combustion of the hydrogen thus obtained. The apparatus consists of a small copper boiler, provided with a safety-valve and a pipe, which passes into a tubulated bottle with two necks placed near the boiler. From this second tubulated vessel another tube passes under the boiler. About half a gallon of water is poured into the latter, and about half a litre of weak tar-water into the tubulated bottle. A spirit-lamp being applied to the boiler, the steam thus generated penetrates into the bottle, where it yields its oxygen to the tar, by which oxide of carbon is generated. The hydrogen of the steam being thus set at liberty, accumulates in the bottle, and then passes through the second tube to the bottom of the boiler, where it meets the flame of the spirit-lamp. On the spirit-lamp being taken away, the hydrogen generated, burns with its own flame, and makes the water boil; this engenders fresh steam, which is decomposed as before, and furnishes a new supply of hydrogen, which feeds the flame, and so on until the water in the boiler is exhausted: all that is to be done in order to have a perpetual flame, is to keep up the supply of water; and also, when necessary, to renew the tar-water. The inventor it is stated, has successfully applied his discovery to steam-engines and locomotives so as to produce an immense saving of fuel.

Aromatic Vinegar, for fumigating sick rooms, &c. The following will be found to be an economical method of diffusing a healthful, agreeable, and highly penetrating disinfectant odour in close apartments, or wherever the air is deteriorated:—Pour common vinegar upon powdered chalk, until effervescence ceases. Leave the whole to settle, and pour off the liquid. Dry the sediment, which place in an earthen or glass plate, and pour on it sulphuric acid (oil of vitriol) until you perceive white fumes to arise. This vapour quickly spreads, is very agreeably pungent, and acts as a powerful purifier of vitiated air. Concentrated and reduced again to a liquid state, it constitutes the "aromatic vinegar" of commerce.

ACCIDENTS FROM MACHINERY.

Chemical Works.—A workman, recently, was killed by the bursting of an iron column at the chemical works of Mr. Frank Clark Hill, in the Greenwich Marshes. Deceased was attending to the discharge of certain chemicals from a tap; the preparation, after being supplied to a receptacle at the top of an iron column, passing through different chambers, the columns being so constructed as to allow of pipes for the conveyance of admitted steam. The steam not appearing to pass off so freely as usual, the deceased ascended to a gallery at the top of the column to ascertain the cause, when the steam-pipe suddenly burst, hurling heavy iron plates, forming the column, a great distance, and killing the deceased on the spot. At the Coroner's request, the jury having expressed a desire to have evidence of a scientific character, as to the cause of the explosion, the inquiry was adjourned for that purpose.

A Fatal Fly-wheel Accident occurred, recently, at Consett Iron Works, Co. Durham. Whilst several men were busied in mill-rolling iron for railway-plates, the fly-wheel suddenly broke. The wheel was making 70 revolutions a minute; weight, about 80 tons; diameter, 4 ft. The principal portion fell into the wheel-pit; but several pieces flew off right and left. One fragment, weighing about 3½ tons, was driven a distance of 29 yards, and struck against a wall, making a breech in it of 4 ft. deep and 2 ft. in breadth, passing on another 21 yards. Roof of mill shattered 160 ft. in length, and 40 in breadth, falling upon four men at work cutting iron at the shears, in front of the fly-wheel. The men were buried beneath the ruins—one killed on the spot; the remainder dreadfully crushed and otherwise injured.

At the "Great Eastern," the first fatal accident (during the fitting of the vessel for sea) occurred (30th May ult.) to a labourer, who was killed by an iron block falling upon his head. He was immediately removed to the *Dreadnought* Hospital-ship, where he died about two hours afterwards.

Soap-boiling Works.—A frightful accident occurred to a workman employed at the extensive soapery of Mr. Soames, in Greenwich Marshes. Deceased was superintending the boiling of an immense quantity of liquid, when the boiling soap-lees overflowed, scalding him in so shocking a manner, that his recovery (at Guy's Hospital, where he was conveyed) is almost despaired of.

LIST OF NEW PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 21st February, 1859.

474. P. Spence, Pendleton, Lancashire—Manufacture of alum. *Dated 11th March, 1859.*
626. R. Hellard, Taunton—Reaping and mowing machines.

Dated 18th March, 1859.

688. R. Clegg, Islington, and R. Fell, St. Ann's-pl., Limehouse, Middlesex—Apparatus for obtaining aërated fresh water from salt water.

Dated 22nd March, 1859.

730. T. Manlove, Radford-grove, and W. Hodgkinson, New Lenton, Nottinghamshire—Manufacturing textile fabrics in imitation of loom-made fabrics.

Dated 31st March, 1859.

808. D. B. White, Newcastle-upon-Tyne—An improved indicating gauge lead or plummet.

Dated 1st April, 1859.

818. W. E. Newton, 66, Chancery-lane—Cricket bats.

Dated 5th April, 1859.

852. F. C. Bakewell, 6, Haverstock-ter., Hampstead—Fire places. *Dated 8th April, 1859.*
884. W. E. Newton, 66, Chancery-lane—Telegraphing and telegraphic apparatus.

Dated 11th April, 1859.

902. W. Boaler, Manchester—Manufacture of soap.

Dated 15th April, 1859.

946. G. Abeillou, Toulouse, France—An extensible arching plane. *Dated 18th April, 1859.*
976. W. E. Gedge, 4, Wellington-street South, Strand—Safety apparatus for clearing off condensed steam from steam engines.

Dated 19th April, 1859.

984. W. Gosling, 82, Wellington-st., Woolwich, Kent—Rifle cannon and projectiles.

Dated 20th April, 1859.

998. J. Apperly and W. Clissold, Dudbridge, Gloucestershire—Apparatus for oiling wool.

Dated 23rd April, 1859.

1012. H. Keach and G. H. Farrington, Bush-lane, London—Improved advertising circulars.

Dated 26th April, 1859.

1044. W. Mackenzie, Glasgow—Method of printing impressions upon an enlarged or reduced scale, either from engraved plates, electrotypes, or other surfaces.

Dated 27th April, 1859.

1056. J. Stuart, Musselburgh, Mid-Lothian, and W. Stuart,—Apparatus for manufacturing nets for fishing.

Dated 28th April, 1859.

1065. C. Randolph and J. Elder, Glasgow—Steam engines and boilers.
1067. R. Harrington, 3, Colonnade, Albany-rd., Camberwell—Umbrellas and parasols.
1069. N. J. Holmes, Glasgow—Electric telegraphs.
1070. E. Lardenois, Brussels—Manufacture of pulp for paper.
1071. T. Clarke, Hackney—Pulleys for paying out and hauling in ropes, chains, and cables.
1073. W. A. Tompson, 18, Cecil-st., Strand, and W. Green, Thames Ditton, Surrey—Apparatus for applying liquids to the throat and air passages for medical purposes.

Dated 29th April, 1859.

1076. W. Corbett, Clayton, near Manchester, and W. Carmont—Arrangement of furnaces employed in the manufacture of iron and steel.
1077. J. W. Welch, Manchester—Sizing or dressing yarns or threads for weaving.
1079. E. A. Porteus, 18, Warwick-sq., Paternoster-row, and W. H. Burke, 79, Cannon-st. west — Printing presses.
1081. T. Smith, Bredfield, Suffolk—Cultivating implements.

Dated 30th April, 1859.

1082. W. Winstanley and J. Kelly, Liverpool—Pumps.
1083. J. Toussaint, 1B, Welbeck-st., Cavendish-sq.—A new process of modelling and moulding for galvano-plastic.
1084. J. Darlington, 36, Cannon-st.—Zinc retort furnaces.
1085. E. Francis, Wrexham, Denbigh—Apparatus applicable to the treatment of tea.
1086. J. Morison, sen., and J. Morison, jun., Paisley—Looms.
1087. W. Clark, 53, Chancery-lane—Supplying air to diving bells and divers.
1088. A. McKechnie, Carron, Stirling, N.B.—Hammers.
1089. J. Bull, Port-st., Manchester—Apparatus used for securing bales of cotton.
1090. C. H. G. Williams, 39, Regent-sq., Gray's-inn-road—Manufacture of coloring matters.
1091. J. Souquière (called Emile), 29, Boulevart St. Martin, Paris—Improved process for distilling coal.

Dated 2nd May, 1859.

1092. T. H. Arrowsmith, Bolton—Carding engines.
1093. A. Jumelais, Paris—An apparatus yielding illimited power, "so called French movement."
1094. J. Ferguson, Kilmarnock, Ayr, N. B., and J. McGaveny, Glasgow—Fasteners for shutters and similar uses.
1095. W. Bayliss, Wolverhampton—Manufacture of iron hurdles and fencing.
1096. R. A. Brooman, 166, Fleet-st.—Electro-magnetic engines.
1097. J. Basford, Brick-yard, Oundle, Northampton—Apparatus used when expressing clay or brick-earth through dies.
1098. J. Childs, Windsor House, Putney, Surrey—Manufacture and useful application of certain alkaline silicates.

1100. D. Moore, Brooklyn, New York—Machinery for rubbing or dressing types.
1101. W. Gossage, Widnes, Lancashire— Manufacture of caustic soda and carbonate of soda.
1102. C. Nuttall, Rochdale—Apparatus for grinding wire-cards.
1103. F. W. Emerson, 110, Fenchurch-st.—Treating ores to obtain a new metallic substance and its salts.

Dated 3rd May, 1859.

1104. A. G. Franklin, 14, South-st., Finsbury—Manufacture of crayons.
1105. W. Johnson, 47, Lincoln's-inn-fields—Manufacture or production of mineral oil and grease.
1106. T. W. Miller, Portsea — Apparatus for generating steam.
1107. W. Clark, 53, Chancery-lane—Obtaining or extracting quinine and the principal organic alkalies.
1108. W. Sellers, Philadelphia, U.S.—Couplings for shafting.
1109. W. Sellers, Philadelphia, U.S.—Machinery for making screw bolts and nuts.
1112. H. Chapman, Battlebarrow, Appleby, Westmoreland —Military camp-cooking apparatus.
1113. H. Chapman, Battlebarrow, Appleby, Westmoreland —Construction of kettles.
1114. E. W. Scale, Merthyr Tydvil, Glamorganshire—Railway signals.
1115. R. Mushet, Coleford, Gloucestershire—Manufacture of cast steel.

Dated 4th May, 1859.

1116. W. H. Kingston, A.B., Trinity College, Dublin—Communication between the passengers and guards.
1117. C. F. Vasserot, 45, Essex-st., Strand- An improved form of tuyere for blast furnaces.
1118. J. Adolphus, 1, Serle-st., London—Locks, bolts, and latches.
1119. W. E. Newton, 66, Chancery-lane—Steam boilers.
1120. J. G. Willans, 2, Clarence-pl., Belfast—Utilizing bog stuff or peat when applied for treating metals.
1121. J. G. Wilson, 1, Langley-pl., Victoria-park, Manchester—Machinery for cleaning cotton.

Dated 5th May, 1859.

1122. H. Turner, Park-st., Mile-end—Steam engines.
1123. J. F. Allender and D. Rowley, Brierley-hill, Staffordshire—Shears for cutting boiler plates and sheets.
1124. J. Schofield and W. Cudworth, Milnrow, near Rochdale—Apparatus for spinning cotton.
1125. H. Chapman, Battlebarrow, Appleby, Westmoreland —Appliances for protecting ships against injury from shots, shells, or other warlike projectiles.
1126. H. Chapman, Battlebarrow, Appleby, Westmoreland —Construction of fortifications.
1127. W. F. Batho and E. M. Bauer, Salford, near Manchester—Drills for recessing, cutting slots, keyways, and cotter holes.
1128. E. T. Hughes, 123, Chancery-lane—Manufacture of sheet iron.
1129. W. Clark, 53, Chancery-lane — Seed depositors or drills.
1130. A. Knox, 2, Victoria-cottages, Hertford-rd., Kingsland—Gas regulators.
1131. H. Reynolds, Denmark-hill, Surrey—Refining sugar and other saccharine substances.
1132. R. A. Brooman, 166, Fleet-st.—Cannon and other fire-arms.
1133. H. Fletcher, 42, Southampton-buildings, Chancery-lane—A machine for scutching and carding tow, oakum, or waste cordage.
1134. W. E. Newton, 66, Chancery-lane — An improved steam gauge.
1135. W. E. Newton, 66, Chancery-lane—Fish-hooks.
1136. J. H. Johnson, 47, Lincoln's-inn-fields—Pianofortes.

Dated 6th May, 1859.

1137. W. Kellingley, 13, Mason-st., New Cross, Surrey—Lubricating the journals of the axles of locomotive engines of carriages and machinery.
1138. F. Angerstein, Kennington, R. Clegg, Islington, and G. Thorrington, Egham, Surrey — Apparatus for obtaining motive power.
1139. F. W. Hart, Horncastle, Lincolnshire—Photographic apparatus.
1140. S. Wright, Sudbury - Gas governor or regulator.
1141. J. Dixon, Blackburn—Apparatus for staining paper.
1142. T. Jones, Liverpool—Flues for heating and ventilating buildings, ships, and other structures.
1143. W. S. Booth, Birmingham—Improved washing machine.
1144. J. Frearson, Birmingham — Fastenings for wearing apparel.
1145. G. T. Bousfield, Loughborough-park, Brixton—Apparatus for grinding grain and other substances.

Dated 7th May, 1859.

1146. J. Combe, 23, Rue du Champ de Mars—Apparatus for measuring the hoofs of horses for the purpose of forming their shoes.
1147. J. Bray, Staley Bridge, Chester, and J. W. Harrison, Staley Bridge, Lancaster—Apparatus for spinning fibrous materials.
1148. A. C. Bamlett, Middleton Tyas, Yorkshire—Reaping machines.
1149. M. Henry, 84, Fleet-st.—Manufacture and construction of locks and fastenings.
1150. R. Mushet, Coleford, Gloucestershire—Puddling iron and steel.
1151. R. Mushet, Coleford, Gloucestershire—Manufacture of iron.
1152. C. Frost, Sun Tavern Fields, St. George's-in-the-East —Construction of electric telegraph cables.
1153. R. Pearsall, Smethwick, Staffordshire—Manufacture of glass shades.
1154. W. E. Gedge, 4, Wellington-st. South, Strand — Manufacture of steel.
1155. R. D. Kay, Accrington, Lancashire—Preparation of certain colouring matters.
1156. W. Jeffery, Eastgate-st., Gloucestershire—Rendering more convenient out-door manipulations in photography by means of an improved portable photographic tent and tent camera.

Dated 9th May, 1859.

1157. J. Ramsbottom, Crawshaw Booth, near Rawtenstall, Lancashire—Machinery for printing fabrics.
1159. C. A. H. Marcoux, 71, Rue de Ruisseau, Montmarte, near Paris—A new impelling mover by the pressure of water.
1160. F. V. Hadlow, 8, Prince Albert-st., Brighton—Stamp for marking wearing apparel.
1162. A. V. Newton, 66, Chancery-lane—Lamps.
1163. A. Morton, Morton-pl., Kilmarnock, Ayr—Apparatus employed in the weaving of figured fabrics.
1164. E. T. Hughes, 123, Chancery-lane—Obtaining motive power.
1165. T. Green, jun., Old Broad-st.—Apparatus applicable to steam boilers, to obtain greater security against explosion.
1166. N. Barker, Heyford, and J. A. Carter, Blisworth, Northamptonshire—Apparatus for lubricating the pistons of steam-engines.

Dated 10th May, 1859.

1167. Major W. F. Nuthall, North-lodge, Kilburn—Ordnance and fire-arms.
1168. R. J. Lees, Woolley Bridge, near Hadfield, Derbyshire —Steam generators or boilers.
1169. W. Wilkinson and C. Whitley, Manchester- Buttons and fastenings for garments, harness, and other similar purposes.
1170. M. Defries, Houndsditch—Apparatus for regulating the pressure of gas.
1171. J. Norman, Glasgow—Furnaces.
1172. R. Thomson, Glasgow—Shuttles.
1173. G. Bell, Wandsworth, Surrey—Matches or fusees.
1174 M. Henry, 84, Fleet-st.—Heating and supplying air.
1175. W. Keiller, Perth—Cartridges for guns or small fire-arms.
1176. W. O. Bourne, New York, U.S.—Apparatus for separating metals.
1177. J. Absterdam, New York, U.S.—Impregnating illuminating gas with hydro-carbon vapour.

Dated 11th May, 1859.

1178. A. Manbré, 10, Rathbone-pl., Oxford-st.—Method of extracting and purifying sugar, called glucose and "sirop de fecule," from potatoes or fecula, for the purposes and uses of brewers, colouring-makers, or otherwise.
1179. A. Manbré, 10, Rathbone-pl., Oxford-st.—Colouring matter for colouring spirits, beers, vinegar, and other liquids, from sugar produced from rice, maize, carrots, turnips, and Jerusalem artichokes.
1180. T. P. Bennett, Gilnow Mills, near Bolton-le-Moors, Lancashire—Carding engines.
1181. J. Luis, 1B, Welbeck-st., Cavendish-sq.—Burling and napping machine.
1182. H. Clarke, Wakefield—Balancing mill-stones.
1183. M. Henry, 84, Fleet-st.— Protecting the mariner's compass against local attraction.
1184. C. F. Vasserot, 45, Essex-st., Strand—Noseband for horses' bridles.
1185. W. Spence, 50, Chancery-lane—Knapsacks and other military equipments.
1186. W. Salter, jun., Lea, Wilts—Hay-making machines.
1187. J. Leadbetter, Leeds, and J. Rhodes, Armley, near Leeds—Pumps.
1188. J. P. Lyall, Castle Frome, Hereford, and W. Campin, Strand—" Saloon," and other omnibuses.

Dated 12th May, 1859.

1189. D. Foxwell, Manchester—Sewing machines.
1190. J. Saxby, Brighton—Mode of securing the rails on railways.
1191. R. A. Brooman, 166, Fleet-st.—Machinery for solidifying, pressing, and moulding.
1192. A. P. Rochette, Brighouse, Yorkshire—Manufacture of soft soap.
1193. T. R. Oswold, Sunderland—Building ships and other vessels.
1194. W. Warne, J. A. Fanshawe, J. A. Jacques, and T. Galpin, Tottenham—Apparatus for covering and insulating wires or conductors used for telegraphic purposes.

Dated 13th May, 1859.

1195. J. Woodley, Church-row, Limehouse—Sawing machines.
1196. T. Scott, Rouen, France—Surface condenser and refrigerator.
1197. W. Clark, 53, Chancery-lane—Knitting machines.
1198. J. F. Allender, Brierley-hill, Staffordshire, and J. Richards, jun.—Furnaces for puddling iron.
1199. W. Whitehouse, New Ferry, near Birkenhead, Chester —Steam-vessels.
1200. R. Gourlay, Glasgow—Making moulds for casting.
1201. T. Vicars, sen., T. Vicars, jun., T. Ashmore, and J. Smith, Liverpool—Manufacture of bread, biscuits, and like articles.
1202. R. A. Brooman, 166, Fleet-st.—Cooking, preserving, and drying animal and vegetable substances.
1203. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for treating india rubber and other similar gums.
1204. W. S. Thomson, St. Martin's-le-Grand — Manufacture of hooped skirts.
1205. J. T. Beale, Greenwich, Kent, and T. N. Kirkham, Upper Halliford, Middlesex—Preparation of colours for dyeing and printing.
1206. G. R. Clover, Liverpool—Ships' night signals.

Dated 14th May, 1859.

1207. J. M. Munro, Bristol—Manufacture and arrangement of chain harrows.
1208. M. Leahy, 53, Hereford-rd., Westbourne-park—Apparatus for facilitating the draught of carriages.
1209. W. E. Gedge, 4, Wellington-st. South, Strand—Dyeing.
1210. D. Smith, Glasgow—Projectiles for fire-arms.
1211. T. Cooper and T. J. Evans, West Bromwich, Staffordshire—Oven or stove for baking, and for drying japanned and lacquered goods.
1212. E. Maw, Doncaster Iron Works, Yorkshire—Construction of buildings made of iron or other metals.
1213. J. Chatterton, 7, Devonshire-st., Islington—Covering wires and other metal conductors for telegraphic purposes.

Dated 16th May, 1859.

1214. S. C. Sheard, Smethwick, Staffordshire—Fire-bars.
1215. E. Adams, Stanton Iron Works, Derby—The employment of machinery for drawing or extricating the gas flames or smoke from furnaces, and forcing the same into them, or into the cupola, to be used as blast or fuel for melting iron or mines of any description.
1216. W. Midworth, Newark-upon-Trent, Nottinghamshire —An improved iron for the use of laundries, tailors, or other purposes.
1217. J. Jones, Dorstone, Hereford—Musical instruments.
1218. J. Clark, Glasgow — Envelopes, and machinery or apparatus for gumming, folding, counting, and otherwise treating the same.
1219. G. Allcraft, Upper Thames-st.—Pressure gauges.
1220. W. E. Gedge, 4, Wellington-st. south, Strand—Mixing, combining, and otherwise treating certain matters and substances for the production of manure.
1221. W. E. Newton, 66, Chancery-lane—Manufacturing instruments for sharpening knives.

Dated 17th May, 1859.

1222. L. D. Owen, 192, Tottenham-court-road—Menstrual receiver or truss.
1223. J. Brown, jun., Rotherham, Yorkshire—Buffers, draw springs, and bearing springs.
1224. A. R. L. P. Gras, and A. L. A. Boucherie—Distilling schist or boghead coal.
1225. H. Dolley, Paris—Manufacture of hooped petticoats.
1226. A. E. C. J. Reynaud de Trets, Marseilles—Composition for splitting rock.
1227. J. Nasmyth, Surrey-st., Strand—Apparatus for obtaining and applying motive power.
1228. C. Law, Wolverhampton—Construction of locks.

Dated 18th May, 1859.

1229. R. Romaine, Chapel-st., Bedford-row—Means of applying steam power to the cultivation of the soil.
1230. A. R. Terry, 24, Great George-st., Westminster — Apparatus for sawing and cutting up loaf sugar.
1231. E. Charlesworth, 3, King William-st., Strand — Counteracting the recoil of small fire-arms.
1232. S. N. Evans, Chapel-yard, North-st., Wolverhampton — Preventing accidents at mines from overwinding.
1233. J. Haslam, Preston—Construction of healds or harness used in warp dressing and sizing machines, and in looms for weaving.
1234. J. Brennand, Manchester—Construction of carriages for the conveyance of passengers, goods, and minerals.
1235. J. Dean, J. Parkinson, E. Riley, and W. Burton, Syke-mill, Haslingden, Lancashire—Certain self-acting mules for spinning fibrous materials.
1236. W. Nicholls, Tregolls-rd., Truro, Cornwall—Portable corn-mills.
1237. J. H. Johnson, 47, Lincoln's-inn-fields—Lubricating certain portions of machinery.
1238. R. A. Brooman, 166, Fleet-st.—Heating.
1239. J. Childs, Windsor house, Putney—Hardening and vulcanizing compounds of sulphur with india rubber and gutta percha.

Dated 20th May, 1859.

1240. J. Valda, London—Stud fastenings.
1241. G. Walker, Old Nickol's-st., Church-st., Shoreditch—Swing looking-glasses.
1242. R. Wilson, Patricroft, near Manchester— Hydraulic machinery.
1243. H. Newman, Liverpool — Construction of artificial teeth.
1244 G. F. Parfitt, Bath—Gas burners.
1245. R. V. Leach, Taibach, Glamorganshire—Manufacture of iron.
1246. D. Kirkaldy, Glasgow—Manufacture of treatment of steel.
1247. J. H. Johnson, 47, Lincoln's-inn-fields—Roasting or calcining of ores.
1248. W. Teasdel, Pier, Great Yarmouth—Coffer dams.
1250. J. P. Budd, Ystalyfera, near Swansea—Manufacture of tin and terne plates.
1251. W. C. Cambridge, Bristol—Thrashing and winnowing machines.

Dated 21st May, 1859.

1252. A. L. Taylor, 16, Ludgate-hill—Harmonican pianoforte.

1253. J. R. Scartliff, Wolverhampton — Construction of lubricating and other cans.
1254. J. Thompson, Witton, near Northwich, Cheshire, and J. Thompson, jun., the Castle, Northwich —The manufacture of salt by an improved and more economical mode.
1255. A. V. Newton, 66, Chancery-lane—Construction of cartridge.
1256. W. P. Savage, Roxham, Downham Market, Norfolk—Traction steam engines.
1257. W. H. Perkin, King David Fort, St. George-in-the-East, Middlesex, and M. Gray, Bonhill, Dumbartonshire—Mordanting and dyeing fabrics of cotton and other vegetable fibres.
1258. T. S. Cressey, Burton-upon-Trent — Machinery for cutting staves for casks.

Dated 23rd May, 1859.

1260. J. H. Brierley, Halifax, and G. Old, Temple-st., Birmingham—A brace buckle.
1261. J. Knowles, Lower Broughton, near Manchester—Power looms for weaving.
1262. R. V. Leach, Briton Ferry, Glamorgan, and T. W. Willett, Pont-Neath-Vaughan, Brecon—Manufacture of tin plates and terne or leaded plates.
1263. W. Crum, Thornliebank, Renfrew—Printing and dyeing textile fibres and fabrics.
1264. G. Burnell, East Hoathly, Sussex—Medicine for the cure of ague.
1265. J. H. Mason and G. L. Baxter, Nottingham—Ornamenting lace or other twisted fabrics.
1266. H. A. Cooke, Chancery-lane—Omnibuses.
1267. J. L. Jullion, Stoneywood Works, Aberdeen, N.B.—Dressing and finishing textile fabrics.
1268. C. P. Moody, Corton Denham, Somersetshire—Machinery for the manufacture of matting or fabric from straw and other vegetable fibres.
1269. R. A. Brooman, 166, Fleet-st.—Axles.
1270. F. J. Bramwell, Great George-st., Westminster—Apparatus for raising ships and vessels out of the water.
1271. W. Clark, Greenock—Apparatus for propelling and manœuvring ships, vessels, and boats.
1272. N. S. Dodge, 44, St. Paul's-churchyard—Treating waste vulcanized india-rubber.
1273. A. Barlay, Kilmarnock, Ayr, N.B.—Steam hammers.
1274. N. S. Dodge, St. Paul's-churchyard — Finishing, colouring, and varnishing india-rubber goods.
1275. A. V. Newton, 66, Chancery-lane—Washing machine.

Dated 24th May, 1859.

1276. J. Stansfield, Batley, Yorkshire—Permanent way of railways.
1277. G. Davies, 1, Serle-st., Lincoln's-inn—Atmospheric apparatus for the submarine transport of blocks of stone.
1278. J. C. Fisher, 51, Catherine-st., Glasgow—Preparing paints and varnishes.
1279. G. D. Jones, Clerkenwell—Machinery for grinding, reducing, and pulverising.
1280. J. Gibbs, Brentford, Middlesex—Treating coal, shale, lignites, and peat, in order to manufacture manure.
1281. W. T. Denham, Wilmington-sq. —Manufacture of coffering machines.
1282. G. Hadfield, Carlisle—Heating and evaporating apparatus.
1283. E. Page, Bedford—Horse drags or rakes.
1284. A. J. Sax, Paris —Wind musical instruments.
1285. B. F. Greenough, Boston, Suffolk, Massachusetts, U.S.—An electrical conductor for submarine telegraphs.
1287. J. Harmer, St. James-st., Lower-rd., Islington—Dry gas meters.
1288. D. S. Price, 7, Green-st., Grosvenor-sq., Middlesex—Production of colours for dyeing and printing.
1289. R. A. Glass, 115, Leadenhall-st.—Submarine electric telegraph cables.
1290. E. Maw, Doncaster Ironworks, Yorkshire—Construction of metallic bedsteads and other furniture.
1291. A. Prince, 4, Trafalgar-sq., Charing-cross—Construction of ships and vessels.
1292. A. Prince, 4, Trafalgar-sq., Charing-cross— Screw propellers.
1293. A. J. Davies, 29, George-st., Hanover-sq.—Apparatus for protecting persons when employed in cleaning windows, painting, or working at the exterior of houses and ships' sides.
1294. J. Mallett, Barnstaple, Devon—Regulator for watches, portable clocks, and timepieces.
1295. A. V. Newton, 66, Chancery-lane —Improved machinery applicable to the manufacture of rivets, bullets, and other like articles.
1296. J. Howard, Bedford—Horse-rake.
1297. C. E. Amos, the Grove, Southwark—Apparatus for raising vessels for repair.

Dated 26th May, 1859.

1298. J. Webster, Birmingham — Pressure and vacuum gauges.
1299. J. Reynolds, 11, Carthusian-st., Charter-house-sq.—Propelling vessels.
1301. C. Dorn, Birmingham—Kilns for baking or burning china earthenware and bricks.
1302. J. Young, Wolverhampton—Locks.
1303. P. Effertz, Manchester—Apparatus for cutting paper, pasteboard and cardboard.
1304. G. F. Chantrell, Liverpool—Construction of charcoal kilns.
1305. W. H. Nevill, Llanelly, Carmarthenshire—Manufacture of steel and wrought iron.
1306. J. Draper, 5, Little Tower-st.—Applying indices to account and other books.
1307. M. Michaelis, Manchester, and R. Kershaw, Heywood —Manufacture of velvets and other piled fabrics.
1308. J. C. Bent, Birmingham—Gas meters.
1309. W. Wright, Deptford—Fastening shirts, collars, and other articles of wearing apparel.
1310. H. W. Patrick, 4, Mill-hill-ter., Acton—Material to be used in lieu of ivory.

Dated 27th May, 1859.

1311. W. Weild, Manchester — Looms for weaving pile fabrics.
1312. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Advertising.
1313. P. Aitchison and T. Binks, Sheffield—Self-acting and other water closets.
1314. L. Farrenc and B. Subra, Paris—Gas lighting by means of direct carburators.
1315. H. N. Nissen, Mark-lane—Book indexes.
1316. G. Hadfield, Carlisle—Apparatus for forming casks or barrels.

Dated 28th May, 1859.

1317. B. Samuelson, Banbury—Machines for cutting roots and other vegetables.
1318. T. Wilson, Birmingham—Breech-loading fire-arms and ordnance.
1319. W. Crum, Thornliebank, Renfrew—Printing and dyeing textile fibres and fabrics.
1320. W. A. Graveley, Upper East Smithfield—Apparatuses for purifying and aërating sea water.
1321. R. A. Brooman, 166, Fleet-st.—Machinery for cleaning, grinding, and bolting corn and other grain.
1322. J. Oldbury, Sumner-row, Handsworth, Staffordshire —Breech-loading fire-arms, applicable to pistols, muskets, carbines, and other guns.
1323. J. Bapty, Leeds—Apparatus for manufacturing felted cloth.

Dated 30th May, 1859.

1324. M. Davis, 5, Lyon's-inn, Strand —Construction of wheels, axles, and boxes for carriages.
1325. A. Smith, 69, Princes-st., Leicester-sq.—Machinery for making lines, ropes, and cables, for telegraphic purposes.
1326. W. Grimshaw, Bowdon, Chester—Machinery for compressing bricks, tiles, artificial fuel, and other similar articles.
1327. E. Breffit, 61, King William-st.—Apparatus for the manufacture of hollow corks.
1328. J. Bruce, Tiddington, near Stratford-on-Avon, Warwickshire—Agricultural drills.
1329. W. Gossage, Widnes, Lancashire—Manufacture of iron and steel.
1330. J. Fry, Wrotham, Sevenoaks, Kent—Mills for grinding.
1331. O. Maggs, Bourton, Dorsetshire—Harrows.
1332. W. Green, Victoria Works, Dod-st., Limehouse — Purifying and treating sugar.
1333. I. Blackburn and R. Blackburn, Long Eaton, Derbyshire—Locomotive and traction engines.
1334. J. L. Norton, Belle Sauvage-yard, Ludgate-hill — Machines for stretching and drying fabrics.
1335. A. Micklethwaite, J. Peace, and S. J. Hobson, Sheffield —Coating of metallic springs, steel, and other metal bands for the use of any kind of machinery.
1336. E. Leeson, 13, Traffic-st., Derby—Machinery for the manufacture of ornamental chenille fringes and braids.
1337. W. Clark, 53, Chancery-la.—Means of reefing and shortening sail in ships and other vessels.
1338. W. Clark, 53, Chancery-la.—Manufacture of leaven.

Dated 31st May, 1859.

1340. J. S. Cockings, Ann-st., Birmingham—Construction of self-adjusting cases for holding and carrying cartridges of various sizes or gauges.
1341. S. Carr and G. Butterworth, Leeds—Manufacture of felted cloth.
1342. E. A. Wood, Victoria-ter., Notting-hill, and D. Rogers, Bromley, Middlesex—Apparatus for raising and lowering boats.
1343. J. Wansbrough, Bridge-st., Southwark—Construction of stereoscopes.
1344. G. H. Smith, Manchester—Sewing machines.
1345. P. Gambardolla, 123, Chancery-la.—Obtaining motive power.
1346. J. J. Lundy, Manchester—Cartridges and gun-wads.
1347. A. Suter, 65, Fenchurch-st.—A furniture castor.
1348. F. Roberts, Maiden Newton, and A. Roberts, Frome, Vanchurch, Dorsetshire—Apparatus employed for ploughing, tilling, or cultivating land, when steam power is employed.

Dated 1st June, 1859.

1349. J. F. Miquel, Paris—Trusses.

Dated 2nd June, 1859.

1351. F. W. Saltonstall, Northumberland-st., Strand, and A. Bush, Hanover-cottage, Park-road, St. John's-wood —Apparatus for dredging and excavating.
1352. M. H. Chapin, 4, Gresham-st.—Galloons, tapes, or ribbons, for supporting steel and other hoops used for distending ladies' dresses.
1353. R. K. Whitehead, Elton, near Bury, Lancashire—Apparatus to be used in bleaching.
1354. S. Wood and J. Wood, Manchester, and P. Billington, Rusholme, near Manchester—Machines for embroidering.
1355. A. Smith and W. Smith Glasgow — Machinery for curing sugar.
1356. S. Bury, Manchester—Apparatus for embossing and finishing textile fabrics.
1357. S. Bury, Manchester—Apparatus for embossing and finishing textile fabrics.
1358. W. H. Parkes and W. Bagnall, Birmingham—Improved ventilator for hats.
1359. T. Whitby, Millbank-st., and W. Dempsey, Great George-st., Westminster—Ordnance and fire-arms.
1360. J. B. Pascal, Paris—Hot-air engines.

Dated 3rd June, 1859.

1361. J. Wilson, St. Helen's, Lancashire—Manufacture of carbonate of soda.
1362. J. Edwards, 77, Aldermanbury — Manufacture of anchors.
1363. R. W. Sievier, Upper Holloway—Smelting and purifying of iron.
1364. J. Onions, Darlaston, Staffordshire—Improved steam boiler.
1365. R. Mushet, Coleford, Gloucestershire—Manufacture of iron and steel.
1366. H. N. Penrice, Witton-house, near Norwich—Machinery for propelling vessels.
1367. J. Kyle, Liverpool—Points for railways and chairs for the same.
1368. J. H. Johnson, 47, Lincoln's-inn-fields — Reducing solid substances to powder.
1369. J. J. Baranowski, Paris—Railway signal apparatuses.
1370. A. R. Arrott, St. Helen's, Lancashire—Manufacture of soda.
1371. Rev. J. Burrow, Ashford Parsonage, Bakewell, Derbyshire, and W. N. Wilson, 144, High Holborn—An improved floor scrubber and sweeper for carpets.
1372. A. V. Newton, 66, Chancery-la.—Balancing millstones.

Dated 4th June, 1859.

1373. H. Crossley, Nailsworth, near Manchester—Jacquard machines.
1374. R. Chrimes, Rotherham, Yorkshire—Apparatus for supplying water to urinals, wash-hand basins, and other similar articles.
1375. E. Gill, the Elms, St. Ann's-road, Wandsworth common—Producing spirit from rice, maize, and other descriptions of grain.
1376. J. Nuttall, Old Accrington, G. Riding, Clayton-le-Moors, and W. Coulthurst, Old Accrington, Lancashire—Size powder, to be used in sizing cotton.
1377. G. Davies, 1, Serle-street, Lincoln's-inn — Wearing apparel.
1378. J. Wood and W. Wood, Nottingham—Method of dyeing lace or other fabrics.
1379. C. James, Mountain Ash, Aberdare, Glamorganshire—Manufacture of railway chairs.

Dated 6th June, 1859.

1382. G. Davies, 1, Serle-street, Lincoln's-inn — Paddle-wheels and screw-propellers for steam-vessels.
1384. W. Green, 2, Victoria-st., London—Mowing machines.

Dated 7th June, 1859.

1386. K. H. Cornish, 5, Essex-court, Middle Temple—Bedsteads, sofas, couches, and chairs.
1388. W. B. Nation, Union-row, Union-bridge, Rotherhithe —Manufacture of superphosphate of lime.
1390. R. Barclay, Bucklersbury—Manufacture of paper.
1392. R. R. Fairgrieve, Boston, U.S., and S. Bathgate, Selkirk, N.B.—Apparatus for winding yarns or thread.

Dated 8th June, 1859.

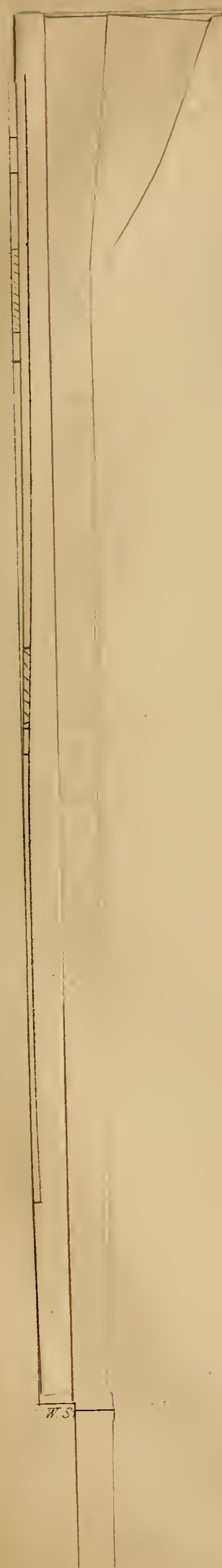
1394. J. Henderson, W. Henderson, T. Bagley, and S. Holdsworth, Durham—Looms for weaving.
1396. J. B. Howell, Sheffield, J. Hick, and W. Hargreaves, Great Bolton, Lancashire—Apparatus for applying heat to steam or other boilers or vessels.
1398. J. B. Molozay, 68, Rue d'Angouleme du Temple, Paris —New means of manufacturing velvet.
1400. A. V. Newton, 66, Chancery-la.—Gas meters.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1249. G. R. Sampson, Massachusetts, U.S.—Improvement in propelling navigable vessels through water—May 20th, 1859.

DESIGNS FOR ARTICLES OF UTILITY.

4172.	May	13.	Elliott, Brothers, 30, Strand, London, W.C., "Improved Levelling Staff."
4173.	„	13.	Charles Lambert and Son, Fillwood Works, near Bristol, "Improved Attachment for Box Fastener."
4174.	„	14.	Edgar Parks, 140, Fleet-st., E.C., "The Etna Kettle."
4175.	„	17.	John Walters and Co., Globe Works, Sheffield, "An Adjustable Vice."
4176.	„	21.	The Permanent Advertising and General Agency Co., Limited, 78, Gracechurch-st., London, E.C., "The Universal Post Advertiser."
4177.	„	27.	Garton and Jarvis, Exeter, "Boilers for Heating Hothouses and other uses."
4178.	„	30.	Charles Dutton and Joseph Jennens, West Bromwich, "Improved Measuring Tap for Drawing Off Stated Quantities with each motion of the handle."
4179.	June	7.	William Taylor, Horsley Wylam, Newcastle-on-Tyne, "Apparatus adapted to be used at Windows and such-like places to facilitate cleaning, painting, and such like purposes."



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ENGINES OF THE "HARRIET LANE" U.S. REVENUE CUTTER,

DESIGNED AND BUILT

AT THE ALLAIRE WORKS, NEW YORK.

1858.

FIG 1. ELEVATION

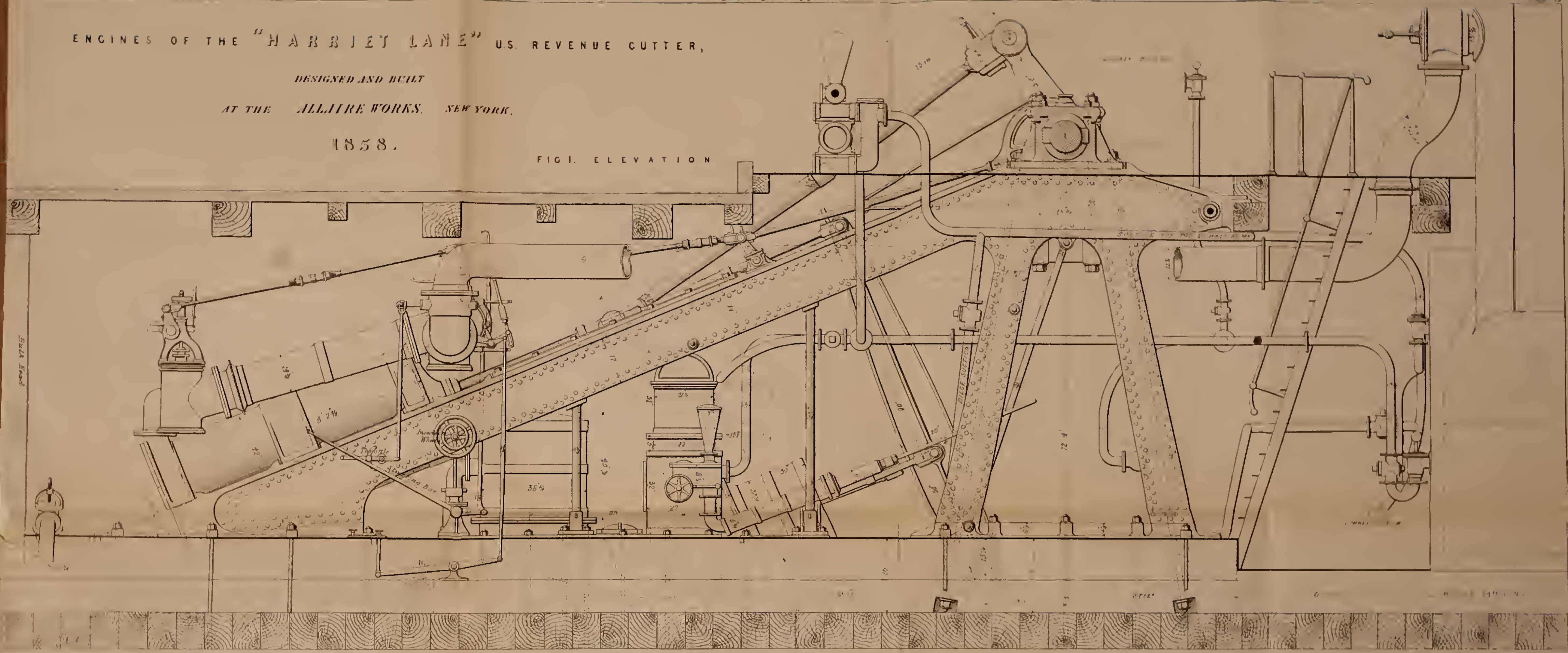
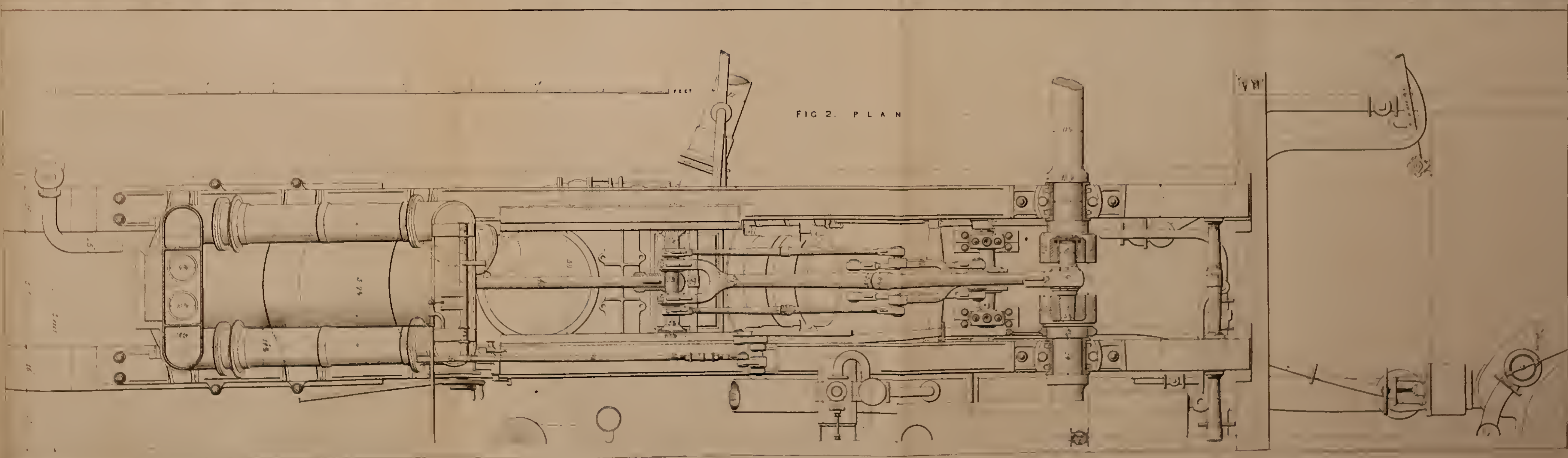


FIG 2. PLAN



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THE ARTIZAN.

No. 199.—Vol. 17.—AUGUST 1st, 1859.

STEAM ENGINEERING IN 1859.

APPLICATION OF STEAM AS A MOTIVE POWER.

In the remarks on Steam Generation, when referring to the evaporative duty of 1 lb. of coal, the temperature of the feed water has been unintentionally omitted ; and to prevent misconception, and give the said remarks the value due to them, it is only necessary to explain, that in all cases 100° is assumed as the feed temperature, for the reasons that this accords with the general working of condensing engines, and has been adopted by the Admiralty as the temperature of the feed in their experiments.

Before leaving this subject, it will be well to remember that the utmost saving which can be realised by supplying boilers with water having a temperature of 212° instead of the usual temperature of 100°, does not exceed 10½ per cent.; many disappointments would be spared if this fact was more generally known and respected.

It may also be explained, that fully admitting an increase of the total heat in steam as it increases in pressure, yet, for the sake of simplicity, all the evaporative statements and comparisons have been made at an assumed atmospheric pressure. In general practice, excluding locomotives, the working pressures on land and sea may be included within 15 lbs. and 45 lbs. per square inch (above the atmosphere) and the additional total heat in steam of 45 lbs. per square inch as compared with that of 10 lbs. is, according to the best authorities, about 7·4°; this is equivalent to a loss of evaporative duty in generating the higher pressure of scarcely ⅘ per cent., and this loss will be increased slightly by the increased radiation.

In the case of the locomotive, with say a pressure of 150 lbs. per square inch, the total heat is about 33° in excess of that of 15 lbs., making a difference in evaporative duty of scarcely 3 per cent. in favour of the latter. It is quite evident, therefore, in comparing evaporative duties under moderate and usual pressures, it is for general purposes unnecessary to notice the difference arising from the varying total heat in steam of different pressures.

After considering the present state of steam generation as regards evaporative duty and economy, it is necessary before passing from the boiler to the engine, to ascertain in what condition steam is supplied and conveyed from the generator to the cylinder.

In land boilers, where space can be easily obtained, steam capacity sufficient to prevent priming is readily ensured; but at sea it is often most difficult in a multitubular boiler to supply steam without an undue amount of water in combination with it.

Among the main causes of priming, are contracted water surface, irregular local evaporation, insufficient steam space, and position of steam exit. The first prevails chiefly in cylindrical tubular boilers; the second more or less in all multitubular boilers; whilst the third and fourth may be found in all kinds of boilers.

Unless positive inconvenience arises, the presence of an undue amount of water with the steam is not readily ascertained. Violent action in the gauge-glass, water in the cylinders, and sometimes loss of vacuum, are almost the only signs of priming; but there can be no doubt, all these symptoms may be wanting, and yet the steam supplied be accompanied with an excess of moisture.

Without superheating the steam (which will be referred to in due course), it is essential in avoiding any unnecessary loss of heat, to supply it with the moisture due only to its pressure and sensible temperature.

Unfortunately, there is no reliable information on which to determine the amount of heating surface required in the steam space; but it must be evident it should be more or less according to capacity, area of water surface, and all those other conditions determining the priming or non-priming qualities of a boiler.

The supply of pure steam is a great desideratum though seldom obtained; little or no anxiety is expressed on the subject, except in extreme cases, when the palpable inconveniences before referred to compel the engineer to supply a remedy.

And now a word respecting the transit of the steam from the boiler to the engine.

On land, as a general rule, there is a considerable length of steam piping between the boiler and the engine; frequently this piping is unclothed, and even when clothed the condensation therein is considerable.

In a Cornish mine, steam power was required under such circumstances, that an unusually long steam pipe was necessary: this pipe was unclothed. The day arrived for setting the engine to work, but it was found impossible to supply sufficient steam to drive the engine alone. The boiler was of the usual description and size for the power; and the failure could not at first be accounted for, but on disconnecting the steam pipe from the engine, it was found that the condensation of the steam in transit was sufficient to abstract 3-4ths of the heat in the steam; as a remedy, the steam pipe was enclosed in a flue, kept at a temperature equal to the sensible temperature of the steam, the result was in every way satisfactory, there being a pressure of 40 lbs. in the boiler and 37 lbs. in the cylinder.

This is an extreme case; but the bulk of factory engines lose a large percentage of their power by similar condensation, which mere felt and canvas or wood will reduce, but not prevent. In marine engines, with thin copper piping (generally placed under the hatchway, supplying the cold air to the boiler furnaces), the temperature of the felt and canvas covering indicates plainly the combat going on between 250° inside and 70° outside. The result is an addition to that condensation, the presence of which every engineer must deplore; and the cylinders are supplied with steam of a different and less valuable character than that generated.

One reason why this, to a great extent useless, condensation exists is ignorance of its exact amount, and often also of its effect in the cylinder, to which we shall refer anon. What would be said of the engineer who supplied his furnace with a constant stream of cold water, or who arranged a shower-bath on the top of the boiler? and yet to produce the effect of such arrangement is the daily orthodox practice of the steam engineer. He readily recognises the difficulty of absorbing the latent heat, and producing a cubic inch of water from steam in the condenser; whilst, at the same time, he is often practically indifferent to the formation of water in the steam-pipe.

Time and experience will undoubtedly show the importance of conserving to the utmost the heat of the steam in transit from the boiler to the engine; and where circumstances require an exposure of the steam-pipe, it will be found that, to avoid a loss more than due to condensation *per se*, it is necessary, by some means, to preserve the working steam at its full temperature and pressure, and arrange that whatever loss of heat and condensation are unavoidable should take place apart from the working steam, in maintaining its temperature and pressure.

Are engineers and users of steam-power alive to the importance of supplying steam-engines with uncondensed elastic steam? We think not, or so many unclothed steam-pipes and cylinders would not be found in use, the former frequently inclined towards the cylinders, so that all the water resulting from condensation is obliged to pass through the engine to the condenser.

Since steam was first employed as a motive power, there has been a constant yearning among engineers for a simple engine, having few moving parts, and those comparatively frictionless; hence the various schemes for rotary, oscillating, and other simple engines; and we have the result of these efforts in the almost perfect specimens of mechanism now produced by our first engineers of the present day.

If a knowledge of, and attention to, the science of steam-power had kept pace with the progress and improvement in the mechanism for producing and applying the same, steam-engineering in 1859 would not be in such a defective state, nor would there be such a serious difference between actual and possible results.

All steam-engines may be divided into two classes—beam or lever, and direct-acting; and in every kind of steam-engine there are two distinctive arrangements affecting the duty realised: the first is the conveyance, use, and disposal of the steam, and, secondly, the mechanism by which the steam pressure is transmitted to the resistance to be overcome.

The pressure and power of the steam being entirely dependent upon its temperature, it follows that the first point to be ensured is the preservation of this temperature.

Boiler supplies Cylinder with a certain amount of steam, containing so many units of heat available for power; what does Cylinder get out of this steam? Why, in the first place, the reception is most chilling, steam parting with much of its heat in warming Cylinder. Generous Boiler makes good the deficiency, until the door is closed, say at 1-4th of the stroke, when, 1-4th only of Cylinder being warmed, the remaining 3-4ths robs the expanding steam, now cut off from Boiler, of a further amount of heat. Cylinder having now got all it can out of steam No. 1, opens the back door, and begs it to make itself scarce, and walk into the condenser, so as not to impede the entrance from boiler of steam No. 2, on the other side of the piston. Directly the water accompanying the exit steam breathes a vacuous atmosphere it begins to evaporate, robbing Cylinder of nearly the whole of its ill-gotten heat derived from steam No. 1; and, not satisfied with this, insists on injection converting it, for the *second* time, into water. These unfriendly acts prevent steam No. 2 from deriving the advantage it had a right to expect from heat supplied to Cylinder by steam No. 1. *Nolens volens*, steam No. 2 has to re-warm Cylinder, receive the extra supply during admission from boiler until the door closes, and then continues the heat-losing process until, like No. 1, it arrives at the end of the stroke in a most reduced condition, and, as the back door opens, rushes, with its companion water, into the condenser, to give further trouble to injection and pumps. After working thus some time, Cylinder stops, and Boiler begs leave to have the accounts looked into. Such a reasonable request cannot be refused; but, after considerable discussion, no balance can be made. Boiler says to Cylinder, "I supplied you with 1,000 cubic feet of steam, which, if rightly employed, should give a duty according to the heat therein, whereas the duty realised is not equivalent to an expenditure of 700 cubic feet; what have you done with the missing 300 ft.?" Cylinder then confesses, with tears (condensed steam), that somehow or other it had borrowed a little heat from steam No. 1 to warm itself, and, at the end of the first stroke, felt quite comfortable, and was in a position to return to steam No. 2 the borrowed heat; but directly the back door was opened, the water left with the steam, as the result of the heat abstracted by the Cylinder evaporated, and took into the condenser nearly all the heat that the Cylinder had borrowed from the steam.

After this confession, Boiler proposed one remedy, and Cylinder another; the former said to Cylinder, "I have more heat in my flues than I require (awkward confession), and will give such an extra supply to the steam I furnish you with, that after you have appropriated as much as you require to keep yourself hot, there will be sufficient left to prevent any condensation."

This remedy was tried, and the result was that on all occasions no difficulty was experienced in making a balance. It is but fair, however, to state that Cylinder (this time without tears, and with a dry skin) was overheard to remark, that "since Boiler's remedy had been in force, it was too much of a good thing," and "he had now more heat than he wanted," and "that he couldn't stand it long without losing flesh."

Cylinder's remedy was to keep itself supplied with, and constantly wear a hot jacket sufficient to keep him at a constant temperature, and prevent stomachic condensation, and after trying this plan Cylinder seemed quite comfortable, and soon saved the cost of the hot jacket.

The above, omitting the remedies, fairly represents the state of affairs in all condensing engines, and is another straw, and rather a large one, on the camel's back.

Water boils in a pure vacuum at a temperature little in excess of that of the atmosphere of an engine-room—so that whatever condensation takes place on the admission of the steam to the cylinder, the water resulting therefrom, is invariably of such a temperature, as to be converted into vapour when brought into communication with the condender, thus this steam is twice generated and twice condensed.

Nor is this diseased condition confined to condensing engines, but exists to a considerable extent even in the locomotive, except when the cylinders are maintained at a temperature equal to that of the working steam, by being placed in the smoke-box, or flue.

In a Paper read before the Members of the Institution of Mechanical Engineers, by Mr. D. K. Clark in 1852, it was shown that in engines with outside cylinders, the condensation therein amounted to 20 per cent. of the total steam used, when it was cut off at one-third, or expanded twice. The greater the expansion the greater the percentage of condensation.

In all cases with clothed or unclothed cylinders, when circumstances have admitted of a comparison between the amount of water evaporated and of steam used, a considerable loss by condensation in the steam pipes and cylinder has been detected, in some cases to an extent of 40 per cent.

Again, it has been found that 1 lb. of coal expended in heating the cylinder is equivalent in effect to five pounds of coal burnt in the furnace of the boiler.

Again, the amount of heat required to keep the cylinder at the temperature of the working steam, has never been found to exceed 10 per cent. of the total heat expended, and in many cases has been less than 5 per cent., whilst with an expansion of 4 or 5 times, the jacket expenditure of 5 per cent. realises an increased duty of not less than 25 per cent.

Again, the injection and air-pumps can be reduced fully one-fourth, when means are adopted to prevent condensation in the cylinders.

It may be added also that the evil effects of water in the cylinders at starting are never experienced, when the cylinders are properly heated.

Watt patented the heated jacket in 1769, and in 1859 not one per cent. of the engines in use, have any arrangements for maintaining the temperature of the working steam, engineers being practically indifferent to the waste such neglect occasions.

Can one heated cylinder be found in her Majesty's steamships of war? if not, will the great men who supply our marine engines to the steam navy, condescend to inform the engineering public, why with their extensive connexion and influence, they are, in 1859, so silent on this important subject, will they not have compassion on us, and prove that they are right in ignoring the maintenance of heat in working steam.

Will the designers of the machinery of the *Great Eastern* explain why a trifle of £2,000 or £3,000 was not expended in ascertaining the truth or fallacy of the alleged economy of such a simple improvement as heating the cylinders?

The remarks on expansion, &c., must be left to the next number.

NEW WESTMINSTER BRIDGE.

In accordance with our promise contained in the May Number of THE ARTIZAN, we have pleasure in presenting our readers with the first Plate of the details of construction of this beautiful structure, which is now making rapid progress, the first half being in a very forward state.*

Before, however, we describe the details, we propose to offer a few remarks on the peculiarities of its construction, and to give a short general description of the bridge.

The New Bridge, as first designed by Mr. Page, was to have either three or five arches; but the low levels of the streets leading to the bridge, and the great traffic that would pass over it, rendered it necessary to reduce its elevation above high-water mark to the lowest point possible, without interfering with the navigation, and in order to secure as easy a gradient as possible, and at the same time not to detract from the appearance of the Houses of Parliament, the number of arches were increased to seven, and their spans and the thickness of the crown of each arch were reduced in proportion.

The centre arch has a span of 120 ft.; the two next it 115 ft.; the next two 104 ft. 6 in.; and the two next, the abutments, 94 ft. 6 in. The width of the bridge inside the parapet is 83 ft., giving two footpaths, each 15 ft. wide, and a carriage-way of 52 ft. wide.

The construction of this bridge is proceeding without the employment of coffer dams, thus saving the expense, and obstruction to the waterway, which would have been incurred by their use. A great diversity of opinion has been manifested amongst engineers as to the correctness of this proceeding; but knowing that it has become an almost universal practice on the continent during the last thirty years to make the foundations and the piers of bridges in deep water, by means of a series of timber-bearing piles, carried up above the bed of the river, near to low-water level, which form part of the pier, surrounding them by a sheeting of timber, filling in the enclosed space with concrete, and the bed of the river being formed and protected outside the sheeting by rough concrete or loose blocks of stone round the pier (certainly not, in our opinion, carried out in so perfect a manner as at the New Bridge),—we must confess that we do not feel that their use is at all required in this instance.

In this country several bridges have been constructed without their use, and the question of permanence of such foundations has been settled by the durability of the piers of Old London Bridge, which were very similar in construction to the New Westminster Bridge, though less bearing piles were employed, where, when the bridge was removed, after a duration of 600 years, the piles were drawn out in a sound state. The tops of the piles were cut off at the low-water level; and though the weight of the houses on the bridge must have thrown a great and unequal pressure on its foundations, and it was exposed to the scour of the ebb tide running like a rapid beneath its arches, yet the bridge stood in excellent order up to the time of its removal. We may remark, that New London Bridge was founded in coffer dams of great size and strength, but, notwithstanding, its piers have settled on the down stream side between 6 and 10 in.

The Old Bridge, which will shortly disappear, was, as we have shown, built on caissons resting on the surface of the bed of the river, which had been previously levelled to receive them; but by the settling of the ground under them the bridge gradually became ruinous.

* We are compelled to defer giving this Plate until next month.—[ED.]

Blackfriars Bridge was also constructed by means of caissons; but the holes in which the caissons were placed had piles driven into them, about 9 ft. apart each way, placed probably rather to obtain an even surface for the caisson bottom, than with a view for support, as they were very shallow, and there were only forty-five in each pier. Their heads were cut off under water. In their evidence before a Committee of the House of Commons, Mr. Rennie and Mr. Walker attributed the stability of this bridge to these piles. Short sheeting piles were driven round the outsides of the caisson bottoms.

In constructing the foundations of New Westminster Bridge piers, elm piles, 14 in. diameter and 32 ft. in length, are driven by a ram of $1\frac{1}{2}$ tons a depth of 19 ft. into the solid London clay, and 24 ft. into the bed of the river.

These piles are disposed in rows of three and five each alternately, to the number of 145 in each pier. The bearing piles are thus 22 ft. below the average level of the caissons of the Old Bridge, and the cast-iron piles and plates respectively 16 ft. 9 in., and 14 ft. below their level; and taking the level of the bed of the river in the centre of the arches to be dredged and maintained as low as the bed of the river at London Bridge, the lower edge of the plates would be 9 ft. below that bed, the iron piles would be 11 ft. 9 in. below it, and the timber-bearing piles 17 ft. below it; while, at the piers themselves, the ground would be 7 ft. higher, giving at the piers a depth from the surface of the bed to the edge of the plates of 18 ft.

Besides the 145 elm piles are forty-four cast-iron piles, 24 ft. 9 in. in length and 15 in. in diameter, driven 23 ft. 9 in. below low-water line, and forty-four cast-iron sheeting piles, fitting into grooves in the cast piles, are driven to nearly the same depth. These flat sheeting piles are each 13 ft. 6 in. long and 4 ft. wide, and are strengthened by flanges or ribs at their backs. 6 ft. below low-water line these iron plates are stopped, and granite slabs 18 to 20 in. thick, embedded in concrete, and resting on the top flange of the flat piles are substituted; and on the heads of the elm-bearing piles is a course of Bramley Fall stones, covering the heads of two or three piles alternately; and upon the top of these the large granite stones are laid, with a projection over the face of the outside piling, so as to form a fender to them. This casing of iron piles and plates around the bearing piles is well driven into the bed of the river, and is also well and strongly tied and bound together, and to the timber piles by wrought-iron tie bolts. Between the piles the bed of the river is dredged to the hard gravel, and the whole space is filled with concrete, so as to form a solid mass. Before the piling for the foundations was commenced, numerous borings of 40 ft., and in one case of 60 ft., were made into the London clay; and the clay in all was found to be of an uniform and dense character. The second or plinth course of granite is carried through the pier, and also a bonding course midway; and the top course of the same material carries the bed plates for the iron girders.

Supposing that the entire weight of the bridge be carried on the elm-bearing piles, we find they would be ultimately loaded with a weight of 15 tons each, or 12 tons per sq. ft. in the pile, which contrasts favourably with London Bridge where the load is 80 tons, and at Hull Docks 25 tons per pile.

The concrete deposited around the piles is of a very dense character, and is composed of Portland cement and gravel; and we gather from the evidence of Robert Stephenson, Esq., and Messrs. Hawkshaw and Fowler, that it is almost indestructible, and, in fact, harder than the stone of the old bridge: this concrete rests upon a dense bed of gravel overlying the clay; and were the concrete to bear the total weight of the structure and load, independently of the piles, the pressure on each square foot would not exceed $2\frac{8}{15}$ tons; supposing the weight to be carried by the entire surface of the pier, the pressure would be 2 tons per foot superficial upon the bed of clay which now carries 6 tons per foot under the old bridge, and nearly the same load at London Bridge.

We thus see that by means of the strong external casing around the bearing piles, the number of iron tie-rods, and the quality of the concrete employed, which is rammed into the spaces around the piles, and also the manner in which it sets and adheres to everything in contact with it, a substructure of great strength and solidity, fully equal to what will be required of it, is rapidly and solidly formed without requiring the usual apparatus of coffer-dams, &c., which are still adhered to as necessary by some of our present engineers.

In our Plate we give the details of the foundations according to the description just given:—

Fig. 1 represents a longitudinal elevation of the foundation of the piers broken off.

Fig. 2 is an end view of the same pier.

Fig. 3 is a cross section through the pier, showing the iron sheeting piles, elm bearing piles, concrete and granite; *a a*, elm bearing piles; *b b*, iron sheeting piles; *c c*, concrete; *d d*, Bramley Fall and granite courses.

Fig. 4 is a half plan, taken on the line A A, Fig. 3.

Fig. 5 is a half plan, taken on the line B B, Fig. 3.

Fig. 6 is a half plan, taken on the line C C, Fig. 3.

Fig. 7 is a cross section through the iron pile and top of iron sheeting pile.

Fig. 8 is a cross section through the same taken half-way down the iron sheeting pile.

Fig. 9 is a cross section through the iron pile, on the line E, Fig. 10, showing the manner of fastening the tie-rods; the dotted lines showing the tie-rod.

Fig. 10 is an elevation of one of the iron piles.

Fig. 11 is a front view of one of the flat sheeting piles or plates, and the dotted lines represent the feathers on the back to give it the requisite strength.

Fig. 12 is an edge view of the same, and Fig. 13 is an end of one of the elm bearing piles, showing the shoes and the mode of attaching them to the pile.

ENGINES OF THE "HARRIET LANE," U.S. REVENUE CUTTER.

(Illustrated by Plate No. 149.)

EARLY in the year 1857 the underwriters and merchants of the City of New York applied to the United States Navy department for a steamer of sufficient power and speed to be employed for revenue purposes nominally, but really for the purpose of affording assistance to vessels in distress along the coast, in the neighbourhood of New York. An Act of Congress was obtained, and the vessel was ordered to be built by Mr. W. H. Webb. The engines and machinery were designed and constructed at the Allaire Works, New York.

Early in 1858 the vessel was launched and fitted with her machinery, and was tried in March of the same year, when she was considered to have performed very well.

Since the time she was completed and tried she has done "efficient service to the State;" and, as her machinery presents some remarkable features, as compared with the engines of any of our own Royal Navy ships, we have thought it would prove interesting to our subscribers, and useful to the profession at large, if we illustrated the engines and boilers of the *Harriet Lane*, as exhibiting another form, and in detail, a different arrangement and combination of parts.

With the present Number we give an extra-large size Plate, showing a longitudinal or side elevation, and a half plan of these engines. We must defer, until another opportunity, the illustration of the boilers.

The hull of the *Harriet Lane* is timber built; her length on deck, 180 ft., and at load line, 177 ft. 6 in.; breadth of beam (moulded), 30 ft.; having a depth of hold of 12 ft. 6 in.; the area of immersed section being at load draft of 10 ft., equal to 270 sq. ft.; the hull and engine-room together having capacity of 640 tons.

Her armament consists of two medium 32-pounder guns upon her quarter-deck, and one pivot-gun forward. She is a good sailer, and, considering her light draft, she has considerable capacity.

The engines, which are inclined direct-acting, will be best understood by reference to the drawing; and every part being drawn accurately to scale, and in its proper place, no textual explanation will be needed, except to state that the two cylinders are of 42 in. diameter, each having a 7 ft. stroke. The two paddle-wheels are each 22 ft. 6 in. diameter over the boards, each of the boards being 8 ft. long, and twenty boards on each wheel. The dip of the wheels on the trial-trip was 4 ft. 5 in.; the maximum pressure in boiler was 25 lbs. per sq. in.; and when cut off at one-half of the stroke, gave $22\frac{1}{2}$ revolutions per minute.

When we are enabled to afford space for the descriptions of the boilers, &c., we intend to furnish further particulars as to the performance of the machinery of the *Harriet Lane*.

DIMENSIONS AND PARTICULARS OF THE IRON STEAM-YACHT "NORA CREINA."

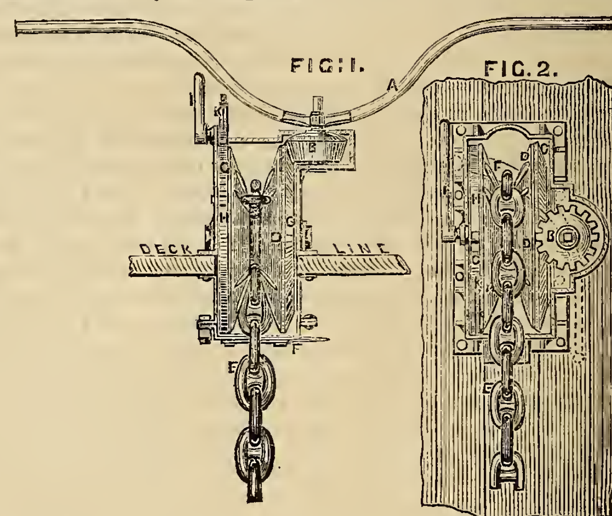
(Illustrated.)

THIS vessel was designed by, and built under the superintendence of, Newbon and Smith, Naval Architects, 63, Fenchurch Street, and fitted with their "Patent Anchor Lift." She has been built for B. H. Hartley, Esq., 137, Leadenhall Street. The hull and engines were contracted for by Westwood, Baillie, Campbell and Co., London Yard, Isle of Dogs. The engines were designed by Harrington, 61, Gracechurch Street.

The following are the principal dimensions and particulars of the *Nora Creina*:—

Material, iron; class, 6 years A 1; built 1859, at Millwall; rig, fore and aft schooner; length over all, 99 ft. 6 in.; ditto between perps, 85 ft.; breadth, 16 ft.; depth, 8 ft. 9 in.; tons, O.M., $102\frac{63}{94}$: number of bulkheads, 4; height between decks, 6 ft. 6 in.; draft of water, 6 ft. 4 in. (mean); nature of engines, direct-acting; name of maker, Westwood, Baillie, Campbell and Co.; nature of boilers, tubular; nominal H.P., 16; ditto indicated, 64; diameter of cylinders, 18 in.; ditto of screw, 5 ft. 9 in.; length of stroke, 12 in.; pitch of screw, 9 ft. 6 in.; coals in bunkers, 14 tons, sufficient for six days; speed, $8\frac{1}{2}$ miles, under steam; water in tanks, 300 gallons; two saloons and ladies' cabin; accommodation for crew, fore peake.

The anchor lift has been well tested since the launch, and has given satisfaction. The anchor is easily stopped by the friction-band, and the vessel rides well by the compressor.



The accompanying illustrations are views of Messrs. Newbon and Smith's Improved Anchor Lift. Fig. 1 being an elevational front view, and Fig. 2 is a plan taken on the deck line: A, being a double lever handle; B, a pinion wheel, gears into the bevel-wheel, C, on one side of chain-wheel, D, having bevel cheeks forming a chain groove, over which the chain, E, passes from the deck into the chain locker. A chain nipper, F, as seen in Figs. 1 and 2, is fitted under the deck, and is worked by a lever on deck. A brake strap, H, and lever, I, is applied on the opposite side of the chain drum, and is worked from the deck; K being a pall taking into the ratchet-wheel, G.

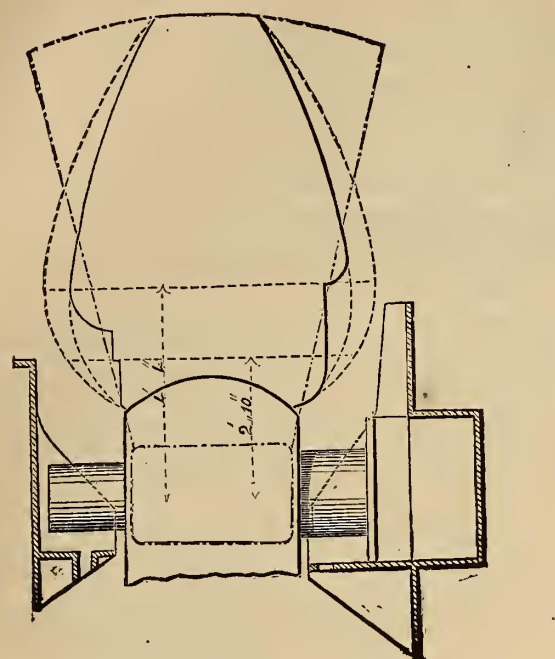
SCREW PROPELLER.—TRIALS ON BOARD H.M. FRIGATE "DORIS."

(Illustrated.)

WANT of space prevented our giving last month, the accompanying wood-cut, exhibiting the several forms of propellers used during the trials on board H.M. frigate *Doris*, and we have now only room to add the following to our previous observations upon these important trials.

The accompanying illustrations are drawn to the scale of one quarter of an inch to a foot; and Fig. 1 exhibits, first, the Admiralty t wo-bladed

FIG: I.



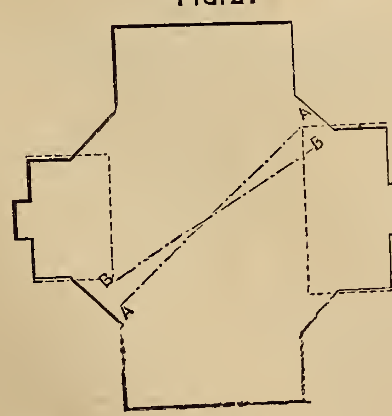
screw in its original condition: this is indicated by the line and ot (— • — •) outline. The alterations made in the Admiralty screw will be understood by the areas formed by the corners, outside of the solid curved line, being removed, in the experiments where the leading or the following corner of each blade was removed for the purpose of testing the Admiralty screw in those conditions against the Griffith's screw.

The full black line exhibits the form of blade which was adopted in these experiments as the Griffith's propeller, but the broken outline orm (— — —), indicating a greater breadth of curved blade, is the correct shape and proportion which should have been given to the Griffith's propeller, to enable a fair comparison to be made; but this increase of breadth could not be afforded for the reasons previously stated.

The sectional lines exhibit the position and form of the chairs on which the screw propeller—when fitted and in its place—revolves.

Fig. 2 is a plan of the well-hole and chairs, and the lines, A A and

FIG: 2.



B B, show the angles of the screw-blade at 4 ft. 4 in. and 2 ft. 10 in. radius respectively.

TAYLOR'S PATENT PORTABLE OR TRACTION ENGINE.

In The Artizan for last month we gave a brief general description of a very excellent common road locomotive or traction engine, recently patented by Mr. Taylor, of the Britannia Works, Birkenhead, which engine, in addition to being an excellent traction engine, has the advantage of possessing facilities for performing the various other duties usually assigned to fixed engines, or the portable engines designed for driving agricultural machinery, and other like purposes; and we illustrated our description by a large plate (No. 148), exhibiting an end view and a side elevation of an engine, which, after being severely tested, has done considerable duty to the satisfaction of the Government authorities by whom it has been employed.

The traction engine lately tested at Birkenhead, and which has since been employed at H.M. Dockyard, Keyham, is what is usually sold as a 5 H.P. engine, but it is only equal to a 4 H.P. engine, at 33,000 ft. lbs. Its total weight is about 9 tons; the wheels are 6 ft. diameter and 10 in. broad on the face, and the two leading wheels 3 ft. 6 in. diameter × 4½ ft. broad—all hung upon springs. Cylinders two, each 6 in. diameter and 10 in. stroke; the speed of the pistons being equal to 200 revolutions of the crank.

The boiler is 4 ft. 8 in. long × 4 ft. 4 in. high, and 2 ft. 9 in. wide. It is constructed partly with flues and partly tubular, having 7 sq. ft. fire-grate surface and 34 ft. of plate heating surface, besides having 24 sq. ft. of tube surface. The boiler was proved, by means of an hydraulic pump, to a pressure of 150 lbs. on the sq. in., but it is not intended to be worked beyond a pressure of 55 lbs. steam. The exhaust steam is led into a catchwater-chamber, which collects the condensed water from the engine, but does not retard the passage of the steam to the blast pipes, which are 1⅜ diameter.

The temperature of the water in the tank is by this means raised to a considerable degree. The capacity of the tank is 130 gallons, but can easily be increased to 200 gallons if required. There are 20 cubic feet of contents in coal-box.

The engine on trial ran at the rate of about six miles per hour light, and with slow speed drew up a log of timber which previously took twelve horses to move. It also drew two loaded waggons, with 11 tons, easily a distance of three miles; and a corner can be turned without any of the driving power being thrown out of gear—it being entirely self-acting. The machinery is so arranged that it can be easily got at for working or repairs; and there is room to carry six persons on the platform.

In a report made by Mr. Danvers to the Honourable the Finance, Home, and Public Works Committee of the Department for India upon the traction engines of Boydell and Taylor, he speaks of Mr. Taylor's engine in high terms of commendation; and we understand that the Indian Government are likely to apply Mr. Taylor's engines very extensively.

THE WRECK-CHART OF THE BRITISH ISLES FOR 1858.

We have lying before us a remarkable map—the Wreck-Chart of the British Isles for 1858. It is to be found in a return to Parliament, carefully prepared by the Board of Trade. The chart is of the same appearance as an ordinary map of these islands, except that the whole line of coast, from the Orkneys to the Land's End, is dotted with a series of black marks. Each mark indicates either a shipwreck or some casualty to a vessel nearly approaching that disaster. A most melancholy effect has this chart when this key to its object is given. The whole coast, particularly approaches to our great commercial cities, bristles with the dottings which indicate clearly the site where some noble ship has gone to destruction with her human freight, the tidings of which has, alas, too frequently brought woe to many a home and counting-house. All round our coast, with the aid of this valuable map, we can trace clearly the frightful work of destruction during the past year. The total number of British merchant ships, including steamers, is supposed to be 27,097, giving a tonnage of 4,558,730. These ships are handled probably by no less than 300,000 men and boys. The nature of the disasters to British and foreign ships is thus epitomized:—In 1858 the number of vessels wrecked on the coast and in the seas of the United Kingdom, was 1,170; of these 354 were total wrecks, 50 sunk by collision—making the number totally lost 404. Vessels stranded and damaged so as to require to discharge cargo 515, by collision 251—total, 766; making the whole number of wrecks 1,170. By these disasters the lives of

1,895 persons were imperilled, of which number 340 persons, or 0·18 were actually lost. This is the dark side of the doleful map. It has, however, a brighter one, and on that we find that by the life-boats of the National Life-boat Institution, those of local bodies, various other craft, and the Rocket Apparatus, 1,555 of our fellow-creatures were, during the past year, rescued from a watery grave. The red dottings on this unique chart are cheering marks, as indicative of the places where life-boats and the life-preserving apparatus are to be found in the hours of distress. The latter are under the control of the Board of Trade, and as the firing of the apparatus requires some knowledge of gunnery, they are principally in the charge of the Coast Guard. It is very gratifying to find that life-boats on dangerous points of the coast have, of late years, greatly increased in number and efficiency under the management of the National Life-boat Institution, whose energies in this good work are untiring. It has now eighty-two life-boat establishments under its management, and we only wish that we were able to report that it had twice that number, for there are still too many exposed points in need of these arks of mercy; and although shipwrecks will occur, notwithstanding all our precautions, yet if life-boats were more numerous on the coast, and if shipowners paid more attention to the condition of their vessels and crews before they sent them to sea, much might unquestionably be done to lessen the melancholy catalogue of disasters on the coasts of the British Isles, which it is our painful duty to report from time to time.

ROWAN'S IMPROVEMENTS IN STEAM-ENGINES.

(Illustrated with 11 Woodcuts.)

We have received numerous inquiries during the last three or four months respecting the performances of the engines constructed by Messrs. Rowan and Co., of the Atlas Works, Glasgow, and although we have replied to numerous correspondents through the post, and furnished them with the address of Messrs. Rowan, to whom we have referred them for further information, we are induced to give the following particulars, which we have obtained in consequence of having received several letters on the subject since the publication of the last number.

The Patent Specification, under which the engines referred to have been constructed, is numbered 856, 1858, the patent being granted to Messrs. Rowan and Horton.

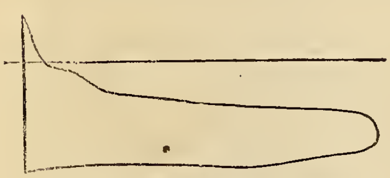
The specification includes improvements in the steam-engine, boiler, and condenser.

INDICATOR DIAGRAMS OF A MARINE STEAM-ENGINE,

by Messrs. ROWAN & Co.—Taken on the 20th November, 1858.

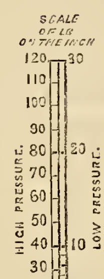
A. High-pressure—Bottom of Cylinder.
Steam in Boiler 115
Vacuum 13
Revolutions 49½

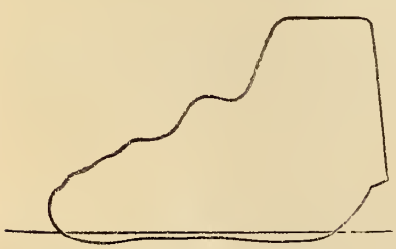
A. Low-pressure—Top of Cylinder.



B. Low-pressure—Bottom of Cylinder.

B. High-pressure—Top of Cylinder.
Steam in Boiler 115
Vacuum 13
Revolutions 52





C. High-pressure—Top of Cylinder.
Steam.................. 115
Vacuum................ 13
Revolutions 53

C. Low-pressure—Bottom of Cylinder.

Area of Pistons.

	Sq. in
High P.	345
Low P.......	1380
	Ft.
Stroke	2½

D. Low-pressure—Top of Cylinder.

D. High-pressure—Bottom of Cylinder.
Steam.................. 112
Vacuum................ 13
Revolutions 52

$$\frac{\text{Coal burned per hour 230 lbs.}}{\text{Indicated H.P. 226}} = 1{\cdot}018 \text{ lbs. per I. H. P. per hour.}$$

The following is Professor W. J. Macquorn Rankine's report upon the trial made the 20th November, and we also supply accurately reduced copies of four sets of indicator diagrams taken upon that occasion, with particulars as to the pressure, &c.:—

1. *Circumstances of the Experiment.*—At 10 h. 25 m. the steamer started from the quay at Greenock, with the pressure in the boiler at 80 lbs. per sq. in. above the atmosphere, and soon attained her full speed. The pressure continued steadily to rise, and at 11·20 had reached 101 lbs. per sq. in. At 11·30, the pressure being about 115 lbs. per sq. in., the condition of the fires was carefully observed, the stoke-hole cleared of coal, the coal bunkers closed, and 448 lbs. of coal, which had previously been carefully weighed on deck, was sent down in sacks for the supply of the fires during the experiment on the consumption of fuel, which was held to commence at 11·30. During that experiment, and for a considerable time after its termination, the pressure (except during an interval when the dampers were closed, to be afterwards specified), never fell below 112 lbs., nor rose above 125 lbs. on the sq. in., and in general remained steady at 115 lbs.

At 12·30, the dampers which regulated the admission of air to the fires were shut, the engine stopped, and the experiment was held to have closed, exactly one hour after its commencement; but as the fires were lower than they had been at 11·30, they were again fed at 12·42 (the dampers being then opened and the engine started), so as to bring them into as high a condition as they were in at 11·30; and the coal so used was included in the consumption of the coal burned during the experiment on the combustion.

The coal remaining on the floor of the stoke-hole was then sent on deck and weighed, and found to amount to 218 lbs., so that 230 lbs. had been used during the experiment of one hour in length.

During and for a considerable time before and after the experiment, the speed of the engine never fell below 49, nor rose above 53 revolutions per minute.

A leakage of steam took place from the stuffing-box of the slide-valve rod; but for this it was impossible to make any allowance.

The steadiness both of the pressure and of the speed, for a considerable time before and after the experiment, showed that the performance during the experiment was no extraordinary effort, but a fair trial.

2. *Power of the Engine.*—The horse power of the engine, as indicated by a series of diagrams taken during the experiment, varied from 221 to 231—the mean being 226.

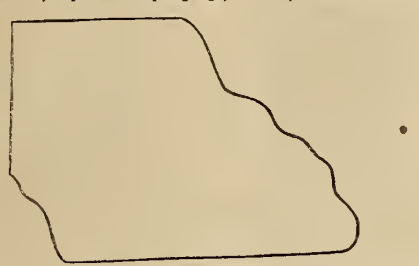
3. *Consumption of Coal.*—The coal burned in one hour, ascertained as already described, with every precaution to make the fires as high at the end as at the beginning of the experiment, was 230 lbs., being at the rate of

$$\frac{230}{226}, \text{ or } 1{\cdot}018 \textit{ lbs. per indicated H.P. per hour.}$$

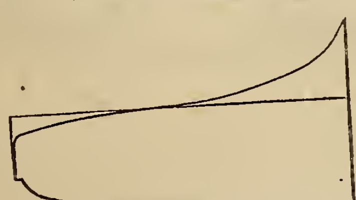
4. *Condensation.*—The surface-condenser acted perfectly, maintaining a steady vacuum of 13 lbs. on the sq. in. It is the most satisfactory example of surface condensation that I have ever seen. They have a horizontal air-pump by which they loose about 1 lb. of vacuum.

In addition to the above interesting particulars, we have been able to procure two diagrams taken upon a more recent occasion, February 8th, 1859, which go to support the previous experiments. The one diagram being taken on the top side of the high-pressure cylinder, which is, as before stated, 21 in. diameter and 30-in. stroke, the steam pressure at the time being noted as 101 lbs. on the gauge, the vacuum being 13 lbs. per sq. in.; the other diagram is taken from the bottom side of the low-pressure cylinder, and which cylinder is, as before stated, 42 in. diameter.

High-pressure, Top. Steam per gauge, 101 lbs., vacuum as before.



Low-pressure, bottom of cylinder, 42 in. diameter. Steam and vacuum as above.



MANN'S PATENT SAFETY APPARATUS FOR STEAM BOILERS.

(Illustrated.)

THE accompanying woodcut exhibits a front elevation of a very simple and ingenious apparatus invented by Mr. Mann, the engineer of the City of London Gas Works.

The contrivance is intended to record the proper attention or neglect to the testing the ordinary water and steam-cocks of boilers, and accurate register of the steam-pressure within the boiler may be secured by the same instrument. It is applied very readily to any steam-boiler, and in any convenient position.

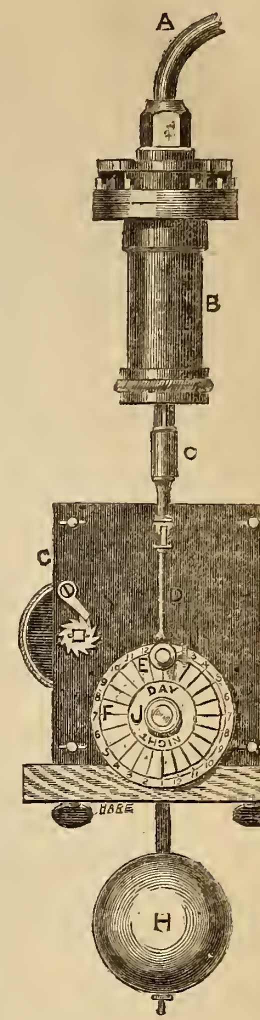
The following is a description of the apparatus:—

The pipe A admits steam to a spring-piston in the cylinder B, which descends in proportion to the pressure of the steam in the boiler; the arm C is fixed to the end of the piston-rod, and is carried downwards with it; the nature of the arrangement will have an *upward motion*, hence, as the pressure of the steam increases, the pencil E, in the pencil bar O, will be drawn up to one of the circular lines of pressure on the diagram paper or card.

E is the pencil, which can be removed in a moment, if required, by simply throwing up the lever, in which condition it will remain until the pencil is replaced, when it is again brought down and left to keep the pencil up to its work by a gentle pressure received from the spring at its upper end.

The eight-day clock, of which the barrel, G, is seen, carries round once in 24 hours a metal disc, to which is fixed by the thumb-screw, J, the paper or card disc having thereon circles corresponding to the steam pressure from zero to 40 lbs. (or higher if required), and radial lines equal to the twenty-four hours of the day.

The apparatus works in the following manner:—Upon the gauge-cocks being tried at the intervals of time during the day or night for which the circular card has been divided, that shown in the accompanying diagram having divisions of one hour, although there may, in practice, be two, four, or more divisions in the hour. The piston is caused by the pressure of steam above it (admitted from a suitable pipe connected with the gauge-cocks), to descend, and carry the pencil downward toward the centre of the card, making a radial mark thereon to an extent corresponding with the change of pressure—the time of opening the cock being recorded by the rotation of the card by the clock-work, so that should the attendant not be present and open the cocks at the proper time, the division or line upon which the mark should have been made will have passed the point of the pencil and the line of its course.



This apparatus is both simple and ingenious. It has been used most successfully at the City Gas Works for many mouths past, and it deserves to be better known and more generally adopted.

We are glad to perceive attention is being called to the want of such apparatus, as will be seen by the following extract from the report of Mr. Longridge, of Manchester:—

"In reference to the boilers which sustained injury, in consequence of deficiency of water, it is mentioned that in one case the explosion was caused by fracture of the blow-off pipe which, during the night, allowed the water to escape unobserved by the watchman, who continued firing after the boiler was empty. In the other two cases the feed-valves appear not to have been tight, and, on preparing to start in the morning, the water in the boilers was driven back by the increasing pressure of the steam, and the furnace crowns much injured in consequence. Though these boilers were provided with glass tube-gauges and floats, these appear to have received no attention at the time, thus pointing out the necessity of employing other means of safety."

REPAIRING DOCK GATES, &c.

(Illustrated by Four Woodcuts).

IN THE ARTIZAN, for April last, we briefly alluded to a very simple and ingenious contrivance, invented and brought into successful operation by Mr. B. Hockin, of the Gateshead Ironworks, Gateshead-on-Tyne; want of space has since interfered to prevent our redeeming the promise then made of furnishing illustrative views of Mr. Hockin's apparatus.

During the repairs of the Sunderland dock gates by Messrs. Hawks, Crawshay and Sons, it was found that the straining rods, roller boxes, and other gear had become set and unworkable; in this state of affairs various suggestions and plans were considered in reference to repairing the damage, and among them coffer-dams, which of course would have entailed a very great expense, both in their application and the stoppage that would be occasioned to traffic through the gates. It being determined by the dock engineer that such stoppage would be most disastrous, a proposal was made to employ divers to remove the ineffective machinery and refix new rollers, &c. Application was made to Mr. Hockin for to obtain men for this undertaking; and seeing many difficulties in the way of obtaining men who were good divers as well as workmen, he set his mind to work to scheme such an apparatus or machine as would enable him to remove the roller boxes, &c. without having to work under water; upon maturing this scheme, he, in conjunction with Mr. Hall, laid it before Mr. Murray, the engineer to the docks, who so far approved of it as to order one to be got ready immediately. After a little difficulty in fixing it against the gate so as to be water-tight, which was ultimately effected by a packing between the gate and caisson, of vulcanised india-rubber, the gate was brought to its bearings, resting upon the steel plate of the caisson, the roller of the box having been previously removed by a diver, the caisson was then pumped out, and the box, straining-rod, &c. removed without any annoyance from the water, and a new set put in to replace them, the gate during this time being frequently opened and shut, in fact, every tide.

"This invention relates to a novel contrivance designed for the purpose of enabling the roller boxes and such like submerged portions of dock gates and their machinery to be removed, repaired, and reinstated without taking down or removing the gates, and without interfering with the opening or shutting of the gates, thereby avoiding the interruption of business which would be consequent thereupon.

The following are the principal parts of his specification:—

"It consists in constructing in plate **T** and **L** iron, or any other suitable material, a caisson of a trough-like or three sided box-like shape, the open side being made to fit against the face of the gate, and a water-tight joint being effected by means of vulcanised india-rubber strips, or strips of other suitable material, close contact being secured by means of straps and bolts and nuts, or by means of lugs and keys, or any other suitable means for securely holding the caisson in its place against the face of the gate.

"The bottom to which the vertical trough-like caisson is rivetted or otherwise securely attached has a strong steel plate with the bottom side rounded off, this plate being thinner at the edges than in the middle; the plate is of a width sufficient to allow of its being partially inserted under the gate, and by means of strips of india-rubber or its equivalent a water-tight joint is made.

"The rounded steel plate is intended to take the place of the roller in supporting the gate whilst traversing upon the circular tram or segmental rail; but instead of, and in some cases in addition to, the rounded steel bearing plate just described, a double cranked strap, with two trunnions or axles projecting from the sides thereof, is fitted to the under side of the caisson bottom, and upon each of the trunnions or short axles, a wheel or roller, each turned to the proper cone, is fitted, and which wheels or rollers travel on the stone flagging of lock bottom (if strong enough), or on temporary iron segments placed thereon for the purpose. In certain cases I may prefer to apply a single roller box to the projecting face of the caisson, either alone or in addition to the rounded steel bearing plate, in which case the wheel would travel upon the original segmental rail or plate; but if used alone, without the rounded steel bearing plate, the strain due to the hanging (or otherwise unsupported) weight of the gate would be thrown upon the caisson, and laterally at a distance from the centre line of the gate, and would be more likely to produce a torsional strain upon the heel post, and also by its projection interfere with the opening of the gate.

"Preparatory to fixing the caisson or box, the gate is lifted sufficiently high to allow the projecting edge of the rounded steel bearing plate to be inserted beneath the bottom rail of the gate, a strip of india-rubber being introduced to insure a tight joint, the roller box being at the same time lifted sufficiently high by means of a straining rod or rods to allow it to come within the line of the bottom of the caisson or box. Strips of india-rubber or other suitable material are attached to the face or edges of the box or caisson, so as to insure a water-tight joint all round, and the caisson or box is then secured to the face of the gate; which being done and found to be water-tight, the gate is lowered until its weight is received on the rounded steel bearing plate, which takes its bearing on the segmental rail; or if either of the variations in the arrangement of the fittings at the bottom of the caisson or box be adopted, they are caused to take their portion of the weight of the gate.

"The water being pumped out of the caisson, workmen may descend to examine and repair the face of the gates, the roller box, or any other part of the gate, machinery, or fittings over which the caisson or box as described has been applied, and the gate may be opened and closed at pleasure, and thus the business of the dock may be continued uninterruptedly, and the caisson or box, when the examination or the repairs have been effected, may be removed and used elsewhere.

FIG. 1.

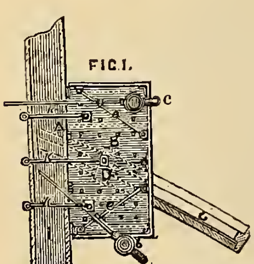
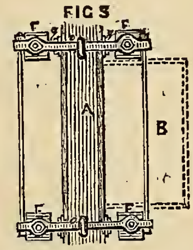


FIG 3



"In the accompanying Illustration, Figs. 1, 2, 3, and 4 exhibit different views of apparatus constructed according to this invention, applied to a dock gate in the manner shewn for the purpose of removing the roller box, &c. for repairs.

"Fig. 1 is plan of the caisson and its apparatus as intended to be applied to the face of a dock gate, the gate being raised; Fig. 2 being a transverse sectional elevation of the dock gate, the lock, sill, and floor, and the caisson and its apparatus, applied to the face of the gate as shewn in Fig. 1.

"In these several views, A is the dock gate; B, the caisson; C, the radial segment or rail, upon which the roller working in the carriage or roller box, D, ordinarily runs; E, the rounded steel plate, which is secured to the bottom of the caisson, and which receives the weight of the gate, and slides upon the radial rail or segmental rail upon which the roller usually works.

"The water levels are indicated in the Figs. 2 and 4, where A' shows the lowest water in docks, and B' lowest water of ordinary spring tides.

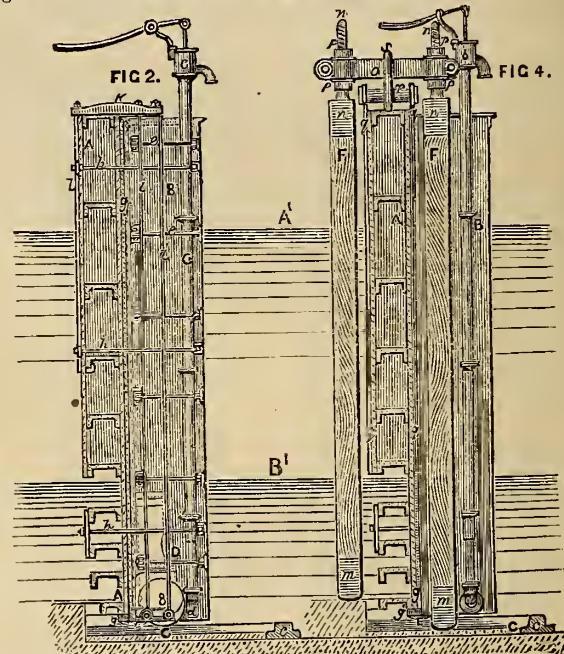
"In Figs. 1 and 2, the original portions of the roller box, D, is shewn, as also the position into which it is drawn up, for the purpose of inserting the bottom of the caisson and its steel plate under the gate, and between it and the radial or segmental rail, the position of the roller box when raised being indicated in dotted lines; the position in which the roller box usually works also is shewn.

"In Figs. 1 and 4 an elbow pipe, *a*, is shown as projecting from one side of the caisson, and to which is connected the suction pipe of a pump, *b*, by which any water in the caisson may be discharged therefrom; another pump, *c*, is shown as set up inside the caisson, having at the bottom of its suction-pipe a rose, *d*, by which gravel, chips, or other solid matters, which would obstruct the working of the pumps are prevented from being drawn into the pump barrel.

"The interior of the caisson is shown as being strengthened by a series of short stays or braces, *e*, *e*, across the two angles, and the vertical angle iron flanches, *f*, having the packing pieces, *g*, of vulcanized india-rubber, or other suitable material, interposed between their faces and the face of the gate, are shown as pressed home and firmly against the gate by means of the bolts and nuts, *h*.

"The vertical rods, *i*, are each attached at the lower end to the bottom of caisson, and the top end of each being screwed and fitted with a nut, passes through a hole in one end of a saddle bar or cross piece, *k*, resting on the top of

FIG 2. FIG 4.



the gate, the other end of the saddle bar or cross piece, *k*, having a similar eye or hole, through which passes the screwed end of a tie bolt or holding down rod, *l*, the lower end of which is secured to the opposite side of the gate to that on which the caisson is fixed, and thus the caisson is supported, and being held firmly in its place, a water-tight joint is secured between the bottom of the gate and the bottom plate of the caisson by means of the elastic packing, *g'*, interposed between them. The middle saddle bar or cross piece, *k*, is shown longer than the other two, so as to admit of its clearing the roller box, D, which has to be withdrawn or raised from its ordinary position for the purpose of repairs or renewal.

"The operation of using the caisson for the purpose of removing a roller box may be conducted as herein-before described, and it will be found generally applicable in such cases.

"For the purpose of fixing the caisson in its place, I prefer to take four timber piles of suitable length shod at the lower end, and fitted at the upper end with a strong bolt having a fork or socket to clip the pile head, as shown in Figs. 3 and 4, where A is the gate; B, the caisson; C, the segment rail; and E, the rounded plate; F, being the piles; the metal shoes, *m*, of the piles may be secured in any convenient manner, and the sockets or clip end of the bolt, *n*, being secured to the head of the pile by bolts and nuts or otherwise; each pair of piles is connected together by means of a cross head or cross bar, *o*, through each end of which one of the bolts of the piles passes, and by means of set nuts or jamb nuts and washers, *p*, *p'*, the piles are adjusted and securely held in their places. Two straps, *q*, having a cross pin or bolt, *r*, between them, are securely attached to the top of the gate, and a link, *s*, is made to connect the cross head or cross bar, *o*, with the cross pin or bolt, *r*. Now, upon placing the four piles in their proper positions, two on each side of the gate, and connecting the cross bars, *o*, by means of the two links, *s*, *s*, with the gate by means of the cross pins, *r*, *r*, the weight of the gate is taken uniformly by the piles, and it is gradually raised by screwing the lower nuts *p'*, up to the bolts, *n*, to any extent required, for the purpose of inserting the bottom plate of the caisson under the gate, the roller box being removed or withdrawn in the most convenient manner, according to the manner in which it may have been fixed or secured to the gate, and the caisson is made secure and water-tight. When the water is pumped out as herein-before described, the workmen may without inconvenience descend into the caisson.

"Although reference has chiefly been made to the removal of roller boxes, it must be understood that for every other purpose for which it is applicable, as, for example, for examination, or for stopping leaks, or repairing other defects, the caisson may be attached to the gates in a similar manner. As hereinbefore stated, I propose, whenever it may be advantageous, to fix a single roller and roller box to the external face of the caisson, and work it upon the existing segment, and by means of a thrusting or straining rod adjust the position of the roller. I also employ, in combination with the caisson and the steel plate, where circumstances permit of their being used, rollers working upon temporary rails or segmental bars, one on each side of the original segment, these rollers being attached to the lower ends of strong bars, and secured to each side of the caisson by brackets in which the roller boxes and the bars slide up and down, the requisite strain being put upon them by means of screw and nut, or in any other convenient manner."

We have given at greater length than usual a description of this contrivance, as we believe that there are many situations in which it may be very advantageously employed; and as we know that it was found of the greatest service in the instance of its application above referred to.

THE ROUEN "REGIONAL" ART-EXHIBITION [EXPOSITION RÉGIONALE] OF 1859.

THE building appropriated to this great Art-Exhibition, which was opened on the 1st July last, but all of whose contributors have not yet forwarded their quota of specimens, consists of a vast quadrangle, having in its centre a wide open space or court. In the covered portions the utmost attention has been paid, and, from our own experience, we may add, most successfully, to the proper and equal distribution of light, which, without fatiguing the eye, is everywhere abundant; an arrangement which, essential as it is to the due success of exhibitions of this kind, is occasionally, elsewhere, all but neglected.

The president and officers connected with the Exhibition received the members of the press, who were invited to attend the opening ceremony, and entertained them at a grand *dejeuner*, which was served in magnificent style in the refreshment department of the Exhibition. After the *dejeuner* was finished, the representatives of the press were invited to attend the reception of the Prefect of the Seine, and the principal Government officials connected with the department. The reception, which was of a semi-official character, having ended, the President of the Exhibition directed the Report of the Council to be read, and also an address, which having been done, the Representatives of the Government were conducted round the building, and the chief objects of interest were pointed out, and the building was officially announced to be opened with the sanction and approval of the Emperor, who, but for his absence in Italy, would have opened the Exhibition in person.

Up to the day of opening about 1,400 industrial manufacturers had answered to the appeal made to them by the "Society of Emulation" of Rouen; and, although a considerable number of the intending contributors have not yet completed their arrangements, enough has been already accomplished to show that the Rouen Regional Exhibition will not only be enabled to take rank with the several local expositions of its kind—its predecessors in France; but, also, that, in an economical and industrial point of view, more especially for those who take an interest in tracing the progress of manufacturing effort in the principal industrial regions or departments of that country, it cannot fail to acquire an importance commensurate with the enlightened views which have led to the undertaking, and which have directed its development hitherto.

Amongst the various branches of manufacturing industry, most amply and brilliantly represented on the present occasion, we may enumerate the cotton and worsted threads, the cotton goods—the varied productions of Rouen itself (known in trade phraseology under the distinguishing designation of "*Rouennerie*")—the cloths and drapery goods of Elbeuf and Louviers, metal work, machinery, chemical products, applicable to manufactures, glass, &c. &c. Various other manufacturing localities also appear there to great advantage; amongst the latter, more especially, Cambrai, Valenciennes, Saint Quentin, and Lille. For the present, and until the contributions are completed, we shall content ourselves with a passing notice of such specimens in the various departments of the Exhibition as appear to us to merit particular attention.

In the "MACHINERY Section," which has been organised by Monsieur Eugene Burel, the eminent Engineer, we have to notice the three HORIZONTAL STEAM ENGINES on the plan of M. Duvoir, of Liancourt, the inventor of these, as likewise of a new system of vertical engines, also exhibited in this department; as also the numerous contributions of Messrs. Dandoy-Maillard, Lueg, and Co., of Maubeuge, the establishment of whose firm dates from the year 1816. The specimens consist of detached parts of power-looms, weaving-frames, spindles, corrugating cylinders, crushing-rollers (of a new construction), and other metal-work, down to carriage-springs, axle-trees, punches, wire-drawing tools, &c., all of them remarkable no less from the excellence of their workmanship than for the ingenuity and novelty of their arrangement.

Foremost in the exhibitors of the "1st Class" (Mechanical Engineering) we may mention Mr. Scott, of Rouen (the last of the representatives of Hall and Co., who established themselves in Rouen some twenty years ago), who continues to manufacture the Dartford form of Wolf engine, with great success; proof of which is apparent in the present specimen, which, as a production of engineering skill, does him great credit. The engine set up by Mr. Scott is placed at the end of the gallery containing "Machinery fixed and in motion," comprised in the First Class; and it sets in motion one-half of the shafting and gearing of this department. It is, as we have before intimated, a vertical Wolf's engine, with variable expansion-gear and condensing apparatus; to this engine and its condensing apparatus we shall hereafter refer.

Messrs. Cail and Co., of Paris have, in the same gallery, and for the like purpose,—that of imparting motion to other of the various machines and apparatus, contributed a horizontal steam-engine (1 cylinder, variable expansion-gear, and condensing apparatus).

Whilst on the subject of the various steam-engines exhibited, we must notice, as worthy of favourable mention, that of M. Boudier, constructed at Rouen, in which Wolf's engine is made, by an ingenious modification of steam-supplying apparatus, to work horizontally; as likewise those of M. Duvoir, of Liancourt, and M. Theureux, of Rouen. In M. Cail's fixed engines the boilers are on the tubular system, the water, before entering the boiler, being rarified by a simple apparatus specially adapted to the purpose.

Amongst the machines in motion, is an automaton "Métier Renvideur," of 1,200 "broches," or "spindles," constructed by M. Chourvade Danguy, of Rouen.

In the "Casting and Metal Work" department, the specimens of drawn or wrought-iron tubing, contributed by Messrs. John Russell, of London [who, by the way, are about to establish a branch establishment at Rouen], are remarkable for evenness and closeness of workmanship.

The "Annéxe" (supplemental department) to this gallery is devoted to agricultural machinery, &c., naval inventions, and the building arts: here, too, we find locomotives by M. Calla, of Paris, Messrs. Cail and Co., M. Artige, and M. Duvoir, respectively.

In the "Marine Section," we notice the anchors and chain-cables of M. David, of Havre; as likewise the life-boat of M. Moué, of Havre. Here, too, we have specimens of the "Industrial Incombustible Buildings" of M. Eugene Burel, consisting of cast-iron girders, following the same radius as the vault in masonry.

The sawing-machine, on a new principle, of M. C. B. Normand, of Havre, offers this peculiarity—namely, that, in addition to its to and fro motion in a vertical plane, another is imparted to it, by which its lower portion takes a backward run, whilst its upper portion makes a slight thrust forward,—the result being, that the teeth of the saw, instead of taking into the entire vertical height of the wood operated upon, cut, in succession, into a short division of it only. Further, at the return stroke, the saws recede from their line of work, so as to free themselves during the up-stroke. These varied motions, which are exactly those of the human hand, are obtained by a very simple arrangement—a modification of the parallel motion.

In copper-plates and coppersmith's work, the immense copper tank from the Romilly establishment of M. Létrauge is conspicuous. Nor can we here omit noticing the copper and brass plates manufactured and exhibited by M. Cubain, of Rouen, successor to M. Boucher, de l'Aigle, and which, as specimens of excellent workmanship in this department, are well deserving of remark.

In FORGINGS we have an iron shaft 25 metres (81 ft. 3 in.) in length by 22 centimetres in diameter, from the forges of Mertian, of Montataire. Likewise very fair specimens of forging from the various iron-works of Rommaire, Montataire, Rasnes, Otshier, of Eure, from which last, indeed, the specimens contributed are highly creditable to M. Albon, master of the forges; and in PLATE-WORK, the copper and brass plates manufactured and exhibited by M. Cubain, of Rouen, successor to M. Boucher, de l'Aigle, are specimens of excellent workmanship; as is likewise a length of tin-tubing, 615 metres (nearly 2,000 ft.) long. 9 millimetres in diameter, and but 1 millimetre thick; exhibited by M. T. Lepan of Lille. Of articles in ALUMINIUM, M. Martin, of Rouen, contributes some excellent specimens. His exertions in this direction have brought down the price of the new metal to 200 francs the kilogramme.

In the "working-in-metal" division, our attention is attracted to the contributions from the foundries and rolling-mills of Romilly, and of M. Cubain, of Rouen, and more especially to the specimens of the wrought-iron work (exhibited by M. Potier-Ferrières) from the Rasnes Forges, l'Orne. In these specimens, the iron is twisted, re-twisted, and bent back upon itself in such bold and complex contortions, as clearly to demonstate the extraordinary toughness and pliancy of the metal employed; not the slightest flaw or opening being perceptible throughout the entire series, which may be characterised as an assemblage of the most elaborate and complicated knot-work.

The specimens of GLASS WORK (in France, a most important branch of national industry) indicate the rapid strides which, it is well known, have been lately made in this direction. From the glassworks of MM. Renard, de Fresnes, exhibitors at the Rouen gathering to a great extent, the annual production of mètres superficial of glass is 800,000 mètres, the works comprising seven melting furnaces and fourteen annealing furnaces, requiring 300 workmen. Of the furnaces, the most ancient date from 1710. This firm were the first in France to substitute coal for wood in their annealing ovens. Another glass firm, that of Messrs. Wagret, E. Sertet and Co., of Excoupone, Fresnes, and Anzin (North), contribute specimens of window-glass and bottles of superior quality. This firm has nine melting furnaces, six for window-glass and three for bottle. In moulded and cut glass, MM. Vve Dupire et Dumont, from the "Gars Potteries" (Nord), exhibit splendid specimens, more especially in cut glass. We have before alluded to the very great extent and importance of the glass manufactures of France—an importance, indeed, of which, in England, we have scarcely a sufficient idea. For the formation of a more practical estimate of the (commercial) value of this branch of trade we have ample data in the galleries of the present Exposition, to which the leading glass-making firms have so largely contributed.

In addition to those already mentioned, there are specimens from the firm of MM. Patoux and Drion, well known in the European trade, who have carried the glass manufacture in the Northern Department to a high state of perfection, employing 600 workmen, and consuming, daily, 600 hectolitres of coal. The glass works of Vauxrot, near Soissons (also contributors of moulded-bottles), have three melting furnaces constantly at work (coal-fed), and producing annually 3,000,000 bottles and 70,000 garden-bells—cloches à jardin. The Masniere glass works, near Cambra (Nord), also contributors, have an extensive connection both home and foreign, chiefly confined to bottles, carboys, dames-jeannes, &c.; they can produce 600,000 bottles per month. Recently, this firm supplied a London house, at short notice, with three millions of bottles, of a shape not used in France, and close-moulded. The glass works of Follembray, Department de l'Aisne, have some handsome specimens of their particular branch, chiefly champagne bottles, for which, up to 1848, they had an almost exclusive demand, from their then well-known title of "Royal Glass Works." They have since then enjoyed a fair share of the orders from Champagne. These bottles, the weight of which does not exceed one kilogramme, resist, usually, a pressure of from twenty-five to thirty-two atmospheres. The Follembray Glass Works have produced, in the last few years, four millions of champagne bottles and half-bottles.

IMPROVED WHEEL PLATE OR LOCKING PLATE FOR FOUR-WHEEL CARRIAGES.

Amongst the really useful inventions collected together by the Society of Arts, and exhibited by them during the months of May and June last, was an invention by Mr. Oxley, which, in our opinion, is so far superior to anything previously designed for the same purpose, that we have selected it as one of the very few inventions really worthy of special notice.

We believe it is now generally admitted that the nearer the fore and hind wheels of a four-wheel carriage are assimilated in diameter the better, and for the small pleasure-carriages now so generally in use, such as broughams, clarences, &c., the difficulty of assimilating the diameters of the fore to the hind wheels arises chiefly from two causes, the one the necessity for extending the fore-boot and increasing the distance between the axles of the fore and hind wheels; and the other, the increasing the distance of the fore-boot from the ground, so as to permit the necessary space to be left for the wheels to turn under in locking, and thus the weight of the coachman is considerably elevated, and the structural form of the carriage rendered necessarily less elegant and weaker.

In all the "wheel-plates" or locking apparatus for four-wheel carriages with which we have been previously acquainted, the locking of the fore-wheels was either a mere pivoting and true concentric turning with all its attendant inconveniences, or as in case of the Buchanan locking apparatus, the surfaces of the upper and lower bed pieces did not remain uniformly in contact to the same extent, and although the locking action was shorter than in the ordinary apparatus, yet the mechanical principle of construction and practical defects were so numerous as to prevent its extensive and continued use, as it soon became disorganised from being unequally strained and worn, and in France, where more frequently than with us utilities are sacrificed for elegances, the Buchanan wheel-plate was at first a great favourite amongst the builders of small carriages, but it soon earned the reputation of being the "chattering" locking plate.

Mr. Oxley, as a practical carriage-builder of many years' experience, and we believe the original designer and manufacturer of the "dog cart," has for years past devoted himself to the improvement of pleasure-carriages, and has long sought to effect such an improvement in the wheel plate or locking plate of four-wheel carriages as, whilst it enabled higher fore-wheels to be used and a shorter lock to be obtained, was of a permanent and lasting character and of superior mechanical construction. In this we are confident Mr. Oxley has now succeeded admirably, and the steadiness which is given by the uniform and unvarying extent of surfaces in contact, and the perfect support given to the superimposed load, whilst in the act of turning, together with the easy translation or change in the direction of motion, does not leave anything to be desired.

The accompanying illustrations, Fig. 1, 2, and 3, are views of Oxley's improved wheel plate as applied to a fore-carriage. Fig. 1 being a plan view of fore-carriage, showing the two flat elliptic bearing-springs and the futchells attached to the improved wheel-plate or locking-gear. Fig. 2, being a vertical section of the wheel plate or locking apparatus taken on the line A B of Fig. 1. Fig. 3 shows the position of the wheel plate or locking apparatus when in full lock, or when the horse or line of traction is at or about a right angle with the longitudinal line of the carriage body.

The following are extracts from the specification of Mr. Oxley's patent :—

"The third part of my invention relates to those parts of four-wheel vehicles technically known as the 'fore carriage' and the locking-plate or wheel-plate, and consists in substituting for the ordinary kinds of apparatus used or employed for turning four-wheel carriages, a novel arrangement or mechanical contrivance, by which a vehicle may more easily than heretofore be turned in a much shorter space, and which also at the same time affords greater safety or security to those driving or to those being conveyed therein, whilst a greater angle may in the same time be made in less distance during the forward motion of a carriage, allowing the centre or turning point to be brought much nearer to the hinder wheels than heretofore, and this increased safety is effected in consequence of the uniform or unvarying amount of working and bearing surfaces in contact between the upper fore carriage and the under or lower fore carriage, during the operation of turning or changing the direction of motion; by this arrangement much higher front wheels, combined with the advantage of shortening the distance between the fore and hind wheels, thereby lessening the draught of the carriage is effected.

"I construct the apparatus connected with the fore carriage of four-wheel vehicles, by taking two flat iron rings or wheel-plates of suitable diameter and strength, having opposing surfaces suitably turned or fitted, each wheel-plate having a bar or transom piece across its diameter.

"I connect them together by a centre-pin or perch-bolt, which passing through the transom or bed-plate, passes into or through and is secured firmly to the opposite bed-piece, at the same time allows the carriage to turn easily on the perch or centre bolt.

"On the opposite sides of the lower transom or wheel-plate I make or fit slides, sockets, clips, or guides, to suit the shape of the slide-bar, in which or through which the slide-bar, hereafter described, is allowed to move back and

Fig. 1.

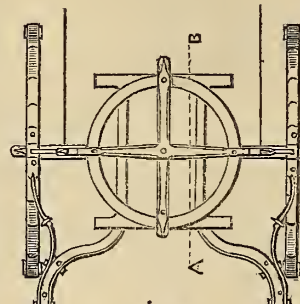
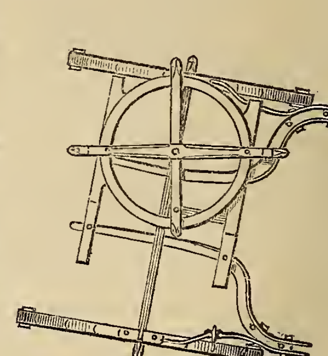


Fig. 2.

Fig. 3.



forth. This slide bar is intended to extend across the whole length of the bottom bed of the under fore carriage, and to be attached to the under bed, and so form the lower transom-plate. From the centre of the slide-bar, and at right angles with it, is forged or otherwise fixed a short bar or connecting piece to the cross end of which the futchells or the splinter-bar are attached; this bar may have a slot through it, or it may be either round, flat, oblong, square, or oval, and in this slot a stud or bolt connected with the upper wheel-plate or transom-plate slides back and forth, each end of the slide-bar or lower transom being connected with or attached to the bottom bed, or the springs, stays, or other fixings.

"The upper wheel or transom-plate is connected to the top bed by means of bolts, and also at each side of the transom-wheel plate; and when the draught is straight, the top bed and the bottom bed are immediately above or over each other.

"From the under side of the front part of the upper transom-plate or wheel-plate, a stud or bolt projects downward; this stud or bolt works the longitudinal slot in the bar before referred to, which is forged or fixed at a right angle with the slide-bar, as before described; or when any other form of bar or mechanically equivalent arrangement is substituted for the pin sliding in a slot, the movement peculiar to this invention will be the same; thus, when the futchells and the bar connecting them with the slide-bar or its equivalent and lower bed piece is moved to the right or the left, the two transom or wheel-plates are moved together or caused to slide along the slide-bar (or transversely to the longitudinal axis of the carriage body) to that end of the bar corresponding with the direction in which it is intended to turn the vehicle. At the same time as both transom plates slide, the lower transom or wheel-plate revolves concentrically under the under surface of the upper transom-plate or wheel-plate, with which it keeps uniformly in contact; thus, whilst the lower transom-plate or wheel-plate turns, it also slides back and forward upon the slide-bar, and is held in its place by means of the sockets or clips or their equivalents. The upper transom-plate, together with the top bed and fore part of the carriage, are fixed to the body of the carriage, and the under carriage turns upon the centre bolt or stud which connects concentrically the upper and lower transom or wheel-plates together.

"Now, instead of fixing a stud pin or bolt to the upper transom or wheel-plate, and having a slot-bar attached to the lower bed piece for receiving the sliding-pin, stud, or bolt, I prefer for some purposes to employ a round or other shaped bar instead of a slot, and an eye bolt or loop to slide over and move along the bar, or a forked bolt to slide back and forward thereon, instead of the plain pin, stud, or bolt moving in the slot or groove of the bar before described.

"Figs. 1 and 2 are detailed views, exhibiting the fore carriage in plan, Fig. 1 showing the position of the parts when in a straight draught, the motion of the carriage and the horse being in the same straight line. In Fig. 2 the positions of the parts are shown due to the line of the pull or draught of the horse being nearly at a right angle with the line of motion of the carriage, the wheel-plate or locking-plate having glided to one end of the guide-bar."

CHARLES BELL BLYTH'S IMPROVEMENTS IN MACHINERY FOR PREPARING AND TREATING JUTE, HEMP, FLAX, AND OTHER FIBROUS MATERIALS.

(Illustrated.)

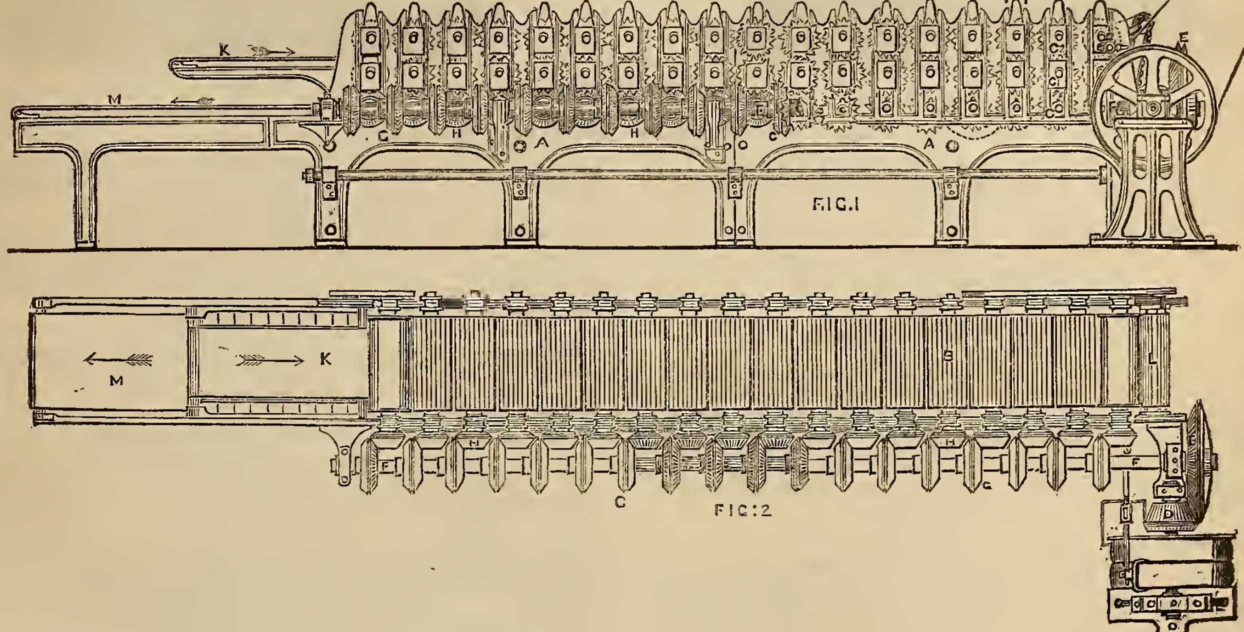
Fibrous materials, such as jute, flax, &c., require preliminary treatment, known as softening, and it is to machinery employed in this operation that this invention relates.

It consists in constructing machines with three or more horizontal rows, tiers, or series of rollers, which are mounted on the machine framing, and driven at a suitable speed, by means of bevel or other gearing. The material to be treated is fed in between two rows of rollers, say the middle and top, or the bottom and middle rollers (when three rows of rollers are employed), and is returned back again between the set immediately above or immediately below those between which it was first fed in. This is effected by means of a return-feeder, which carries the material from between the first set or row of rollers into and between the next set of rollers, in the series composing the machine, and, if found necessary, the material may be passed through the machine more than once.

For the purpose of facilitating the operation of softening, heating pipes are introduced between the side frames in and around the machine.

Fig. 1 exhibits a side elevation of a machine, in which the material to be

BLYTH'S IMPROVEMENTS IN MACHINERY.



treated is fed in between the middle and top rollers, Fig. 2 being a plan of the same.

In the figures, A is the main side frames; B, the rollers, working in bearing-blocks, C, C^1, and C^2, provided for them. The bearing-blocks of the middle and upper series are fitted in vertical openings or guides, in which they slide up and down, to admit of the variation in the distances between the centres of the bottom and middle and the middle and top rollers, produced by the passing of the material through under treatment. Upon motion being communicated to the driving-pulley, by means of a band, the bevil-pinion, D, gearing into the wheel, E, rotates the shaft, F, upon which a number of bevil-pinions, G, are fitted, which drive the bevil-pinions, H, one of which pinions is keyed on to the overhanging end of each bottom roller-shaft. K is an endless band or apron, which carries the material between the rollers, and, after passing between the horizontal lines of rollers, is met at the end by the returning band or hinged series of bars, L, which causes the material to be carried into the next series of rollers, between which it passes, until it reaches the end, and falls upon the endless band or apron, M, from which it is removed.

The greatly increased quantity of material which can be more perfectly treated in a given time, with a less amount of manual labour and power than by any other machinery heretofore employed, gives to Mr. Blyth's machines a superiority which, in so extensive a manufacture as that of the flax trade, becomes a matter of vast importance; and it is not saying too much for th merits of this machine when, looking to its economical working at the Tay Works, Dundee, we state that it is likely to become generally adopted in the flax mills of the world.

ASSOCIATION OF FOREMEN ENGINEERS.

On Saturday, the 2nd ult., at 8 in the evening, the Association of Foremen Engineers held their monthly meeting in the City, Mr. Joseph Newton presiding. The main interest of the proceedings on the occasion centred in a Paper to be read by Mr. Stabler, On the Economical Formation of Steam. That gentleman, at 9 o'clock, proceeded to his task, and in elucidating more clearly his views, reverted to the early days of the steam engine, and said that the theory of combustion had been known since the days of Sir Humphry Davy. The practical application of fuel, however, was still undergoing changes; and although some of our most able and experienced engineers have applied and are applying their talents and skill to obtain the desideratum, the "maximum of mechanical effort with the minimum amount of fuel," yet great differences of opinion existed as to the best form of boiler, and its adaptation to different circumstances and situations, as the sea, the rail, and the factory. Commenting upon the theories of scientific men, and the deductions of practical ones, from Dr. Black and Jas. Watt down to the *savans* and workers of our own time, and giving *en passant* illustrations of their various ideas and experiments, Mr. Stabler further remarked, in addressing himself to the immediate subject of the evening's discussion, that the economical formation of steam depended on perfect combustion, and the absorbing and transmitting powers of boilers. Combustion might be perfect, but the absorption of a boiler might, at the same time, be imperfect, and thus the evaporation of water would inevitably bear a low proportion to the fuel employed.

Mr. Stabler went on to explain his own views, and to recount some details of his own experiences on the highly important subject; and on the conclusion of his Paper a discussion ensued, which protracted the proceedings, but which ended with a vote of thanks to the talented reader.

Mr. Newton announced that Mr. Galloway would, on the first Saturday night in August, read a Paper on "Superheated Steam," and the meeting came to a close.

GUNNERY EXPERIMENTS.

We have been furnished by Lieutenant Engström, of the Royal Swedish Navy, with the following observations upon the different methods pursued by the war authorities of England and France in carrying out gunnery experiments, and as the subject is one which possesses considerable interest, and the paper contains a number of details which may prove useful for reference hereafter by some of the inventors of improvements in gunnery who may have to undergo similar treatment, we give Lieutenant Engström's Paper entire. The accompanying illustrative wood-cuts show Lieutenant Engström's gun and gun carriage before and after having been fired. Fig. 1 shows the position of the gun when being charged for firing about point blank range. Fig. 2 shows the position which the gun assumes after it has been discharged, and by its recoil has caused the back traversing block to which the connecting rods or bars between it and the gun trunnions are attached to ascend the incline at the tail end of the carriage.

Fig. 1.

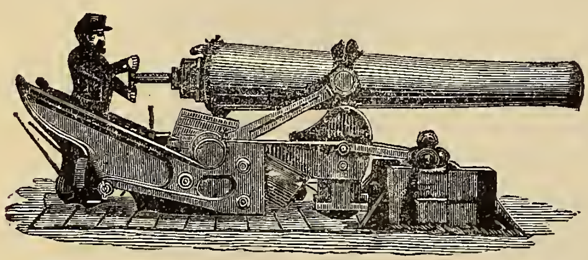
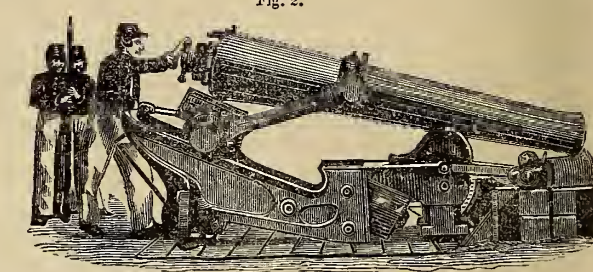


Fig. 2.



To the Editor of The Artizan.

OBSERVATIONS UPON THE DIFFERENT MANNERS OF CARRYING OUT GUNNERY EXPERIMENTS PRACTISED BY THE WAR AUTHORITIES OF ENGLAND AND FRANCE.

TRIALS AT SHOEBURYNESS, 1857 AND 1858, WITH A BREECH-LOADING RIFLED GUN, 32 POUNDS BORE, AND FITTED WITH HIS IMPROVED CARRIAGE OF CAST IRON.

Weight of gun	about	....	5 tons
,, of carriage	,,	....	3 ,,
,, of shot	,,	....	58 lbs
,, of charges from 6 to 10 lbs. of powder			

Gun and carriage invented by Lieutenant Engström, Royal Swedish Navy.

THE BREECH-LOADING APPARATUS.

TRIAL 29th JULY, 1857.

By the superintendent of the experimental establishment at Shoeburyness.

"The breech-loading apparatus worked well and freely, the escape of gas being very *trifling*, but loading was *tedious and slow*. On one occasion the gun missed fire twice, the cartridge being in advance of the vent, while on another, the cartridge was broken by the closing of the breech in consequence of the cartridge not being pushed far enough up the bore; and, from the want of arrangement to indicate to the gunner that the shot and cartridge are in their proper position, such occurrences must be frequent."

TRIAL 19th AUGUST, 1857.

Same officer's report.

"The breech-loading apparatus worked freely, the escape of gas was trifling. Upon the gun, however, being elevated to 10° and upwards, the breech could not be opened until the gun was again depressed, the handle coming in contact with the side of the carriage. Upon each occasion of loading, Lieutenant Engström employed a small wooden cradle, which he placed in that part of the gun in which the breech fits when screwed home. Upon this cradle the shot was placed, and from that position rammed home, its proper seat being indicated by an iron stop on the shaft of the rammer. This arrangement tended *materially to diminish the time that was formerly occupied in loading, &c.* The process was, however, but slow. The gun missed fire twice, in consequence of the cartridge being pushed a little too far up the bore. The gun required to be *sponged frequently and kept very clean;* from neglect of this precaution the shot in two cases could not be forced home, and had to be withdrawn to clean the bore."

On the 5th, 6th and 27th April, 1858, the breech-loading apparatus was further tested, when 60 *round shot* were fired at various angles from P.B. to 10°.

On the 6th April, the same officer reported: "In loading, the gun is sponged out from the breech with a short-staved sponge, while the breech, which opens on a hinge, is washed; a wooden cradle is then inserted into the breech, on which the shot and cartridge, tied together, are placed, and simultaneously rammed into their seat by means of a small rammer with an iron stop attached; the latter, catching against the side of the gun, prevents the charge being rammed too far up the bore; the breech is then closed. *These several operations, perfectly understood by the detachment working the gun, occupied from* 48 *seconds to* 4 *minutes from the word 'load' to the word 'traverse.'* The great difference in time arose from *the difficulty of moving the breech apparatus after firing, in others to get it home. Strong men only can work the breech-loading apparatus, while the utmost attention must be paid to its cleansing.* The gun missed fire 10 times (out of 40 rounds), and this must frequently occur unless the projectiles used can completely resist the blow of the breech apparatus when closing. This operation forces the charges up the bore, and clear of the vent, *when the only alternative* is to ram home from the muzzle."

THE CARRIAGE TRIAL—19th AUGUST, 1857.

The gun was mounted upon a carriage of special construction, fixed by an iron loop to a pivot secured to 6 piles of timber, driven firmly into concrete. *The recoil and reaction were very violent,* the strong piles being considerably shaken after the firing; while in almost every case when the gun "run up," the reaction drove the gun again some distance up the slide.

TRIAL 6th APRIL, 1858.

The gun was mounted upon an iron carriage of a special construction. In some cases the gun after firing did *not return* to its position as intended by the inventor; in such cases the time occupied in "running up" was from 40 seconds to 10 minutes.

THE WHOLE SYSTEM, GUN AND CARRIAGE.

TRIAL AT SHOEBURYNESS, 19th AUGUST, 1857.

The whole arrangement of the gun on this carriage is *very defective,* as the gun moves up and down the sides, according to its position with reference to elevation or depression.

TRIAL 6th APRIL, 1858.

The whole arrangement of the gun on this carriage is very defective. As the gun moves up and down the slide on its trunnions, in proportion to its elevation or depression, it is therefore impossible to give correct elevation

THE RIFLED PROJECTILES.

The superintendent at Shoeburyness reported on the 19th August, 1857:—

—— "20 more rounds were fired, when Lieut. Engström used a hard wood, termed 'hornbeam,' as fids for his projectiles." Upon which occasion, the same officer reported as follows:—

"The hard wood fids passing through the case of the shot were fitted to the rifle-grooves, and were in every instance either cut off or torn out by the discharge. *The shot, however, took the rifle motion, and I am of opinion that the whole proceeded point foremost except the last,* which turned over on leaving the gun."

Observation.—On the trials in April, 1858, there was only fired from this rifled gun *round shots.*

The whole of these Reports were *concurred in* by the Ordnance Select Committee.

RESULT IN ENGLAND.

War Office, March 1, 1859.

Viscount Hardinge presents his compliments to Count Platen, and in reference to his Excellency's note of the 15th inst., has the pleasure of forwarding a memorandum embodying the substance of the Reports on Lieut. Engström's gun. It is believed that he is in possession of the actual results of practice, but copies are enclosed.

In replying whether this gun shall be adopted into Her Majesty's service, the matter may be considered as closed, and answered in *the negative.*

It had been the intention of Major-General Peel to cause a few more shots to be fired for a special purpose of comparison; on the receipt, however, of the shot intended for this comparison at Shoeburyness in the early part of the present month, which were the same as those fired last year, they were found in an unserviceable state, and it is doubtful whether any more will be made.

His Excellency the Count Platen, &c., &c., &c.

OBSERVATIONS BY THE INVENTOR REGARDING THE ENGLISH TRIALS AT SHOEBURYNESS.

2. On the trials—the 29th July and the 19th August, 1857, the reporter says that *loading was slow*, the *process* (I think quick firing) *but slow*. The inventor was present, and asked in the two trials about "quick firing." This was *negatived*, for the reason *that every shot should be taken up*, and the distance *annotated*, and that everything should go after reporter's *order*. It is natural that the firing should be slow when every shot should be found before the following could be fired. The inventor had, therefore, *no command* at the trials; he was the only *spectator* without an opinion. As the English gun was larger than the French, and rifled, and as everything was new, it was natural that all appurtenances could not be ready in a first trial, and that the firing could not go so quick as the French with round shot, but in the trial, 1858, at Shoeburyness, it was even fired with round shot, but as the inventor was not present *the result was given*

In the trial 19th August, 1857, the reporter says that every one of the projectiles, except the last, *proceeded point foremost;* and I think that this is just the only question—viz., *to give rotation of a projectile in such large calibre without any danger to the strength of the gun, and that the peculiar thing for this result* (wood fids through the projectiles), *is the application of a common and simple material, and is in my opinion the only practicable thing for war purposes.*

The projectiles used in England had fids of wood of only $1\frac{1}{2}$ in. breadth and 3 in. long, as *one* of the projectiles turned over at 10° elevation, and with 10 lbs. of powder, this fid was considered not strong enough, and the inventor proposed to the War Department to rifle up the gun again with four grooves instead of two, and to make these 2 in. broad, and to fire with 12 and 14 lbs. of powder. This was agreed to by the authorities, and allowed *due* attention in the *following* trials, but this was *never executed*, and in the *following trials* round shot were employed.

In the trials, 19th August, 1857, as described in THE ARTIZAN of October 1, 1857, the woodcut shows the new projectile; but these projectiles, although unused in England, are becoming extensively employed on the continent.

It is satisfactory to find, after these experiments, that with any wood material softer than *hornbeam* (which corresponds with rolled zinc), it is impossible to give steady rotation to such a great projectile as *a 58-pounder in a 32-lb. bore*, and 10 *lbs. charge* is proved even by other experiments; for instance, in Sweden, where is manufactured breech-loading rifled cannon, with projectiles covered with lead, by Baron Ulahrendorff, for various governments; and with these *forced lead-covered* projectiles the range in 24 lbs. bore is good enough with 4 lbs. charge, but with 5 lbs. charge of powder the distance is diminished considerably, for the reason that lead is *too soft*. Baron Ulahrendorff has recently manufactured, I think, about 40 or 50 such rifled cannon, with the zinc instead of lead.

(*To be continued.*)

CRADDOCK'S IMPROVEMENTS IN THE STEAM ENGINE.

[WE have been requested to afford space for the accompanying papers relating to Mr. Craddock's inventions, the efforts which he has made to introduce them, his want of success, and his claims upon the consideration of the British public for having inaugurated highly economical improvements, which improvements he considers have effected an enormous annual saving to the proprietors of steam power, more particularly to the employers of condensing engines. We give insertion to the following papers with considerable inconvenience to the arrangement of the matter for this month's Journal, and to the exclusion of papers of considerable importance; but we feel Mr. Craddock *has* claims, and those which ought to be promptly recognised and fairly and substantially met, but we have no desire to enter upon a discussion between Mr. Craddock and those by whom he more particularly considers himself aggrieved.—ED. ARTIZAN.]

SIR,—I feel sure you will pardon my drawing your attention to some important improvements in the steam-engine and its boiler, as the present aspect of affairs and the state of our navy render it desirable and proper to do so. These inventions, in a more or less perfect state, have been in work in one or other part of England for the last eighteen years, and during that time have been perfected by me in all their practical details, so that they now present as complete and valuable a combination of improvements as have ever been made in the steam-engine and its boiler.

My adversaries may say what they will, yet the time must come when these improvements will be acknowledged by all as equal to those of Watt; in fact, it is their great practical value that has been the cause of the slow progress I have been allowed to make, as vested interests and envy always have, and probably always will, misrepresent and retard the best things the most. I hope now to get beyond the obstructive influences. To this end I have portrayed the kind of power I have for eighteen years bad to contend against, from which it will be seen how what Providence bestowed as a blessing upon the individual has been converted into the opposite.

After the eighteen years' practical experience in making and working such engines and boilers, I know that the statements given in the enclosed printed paper are to be relied upon as a correct indication of their value for marine and naval purposes.

How enormously, then, is the security and welfare of the people of England sacrificed to the jealousy and mistaken trade interest of a few individuals, who do not count as many score persons as the nation counts millions.

In such a case it is high time that the public should give its attention and its aid to a thing of this kind, as I have done all that an individual can do, and for doing so have been made to suffer a more agonised and prolonged torture than had I been made to suffer half a dozen deaths (if that were possible) upon the block or the scaffold.

In these matters there is always a little public which imagines it has an interest opposed to that of the great public. Therein is engendered the very worst tyrant human nature can produce, as such tyrant is conscienceless and irresponsible, and consequently unrelenting in cruelty to individuals and opposed to the welfare of the public.

No individual tyrant can altogether suppress the whispers of conscience. He also stands before the world as the personal representative of his deeds, and the personal recipient of the moral indignation of mankind. But a trade confederacy imbued with jealousy and arrogating to itself a popish authority, by which it determines who shall, and who shall not, obtain public support, is a human power at once devoid of all responsibility, and which by designating itself, "the public" is effectually screened from the shadow of reproach. Here is a conjunction of all the elements which constitute the very worst tyrant to which an individual can be exposed, and from which I have, for eighteen years, received treatment which has been far more cruel than imprisonment or death.

Under these circumstances, and with the statements in the enclosed printed paper correct, may I be allowed to ask which of the refugees can show that from his labor such productive and substantial good will flow to his country as must inevitably flow to England and the world from such labors as mine have been for the last eighteen years; may I not also hope that by being an Englishman I do not thereby forfeit all consideration from the English public and all right to justice and fair-play.

The prosperity and safety of the nation, and the course of justice will be served by English gentlemen and others directing their attention to these improvements, which constitute something more solid and certain than is to be found in foreign politics and their probabilities, as these improvements present a physical certainty that will bring home to every Englishman's fireside greatly increased comfort and protection, and, at the same time, furnish powerful means leading to peace and goodwill among nations.

I remain very respectfully yours,

THOS. CRADDOCK.

137, *Titchfield-street, Pimlico, S.W., July 7th*, 1859.

P.S.—In relation to the printed information herewith sent, I have selected that paper as conveying in the fewest words and most comprehensive form the leading advantages to be derived from these improvements for marine and naval purposes, but shall feel pleasure in supplying the most ample evidence, by reference to engines made, working drawings, indicator figures, and detailed account of the working of such engines and boilers for a length of time, also references to, and opinions of, persons who have had them in work for years.

The following are the papers above referred to:—

CRADDOCK'S IMPROVEMENTS IN THE STEAM ENGINE.

IT is hoped these papers will obtain a reading, as the subject they refer to is of great importance just now: so also are the advantages therein related, which are the result of a combination of sound abstract principles, worked out and established by eighteen years' practice. Such things, so established, are of no small import, whether in times of peace or war; and it cannot be to the true interest of England to drive their author to a foreign land, but his treatment for twenty years has been of the most cruel and unjust kind, so that he makes this his last effort to awaken Englishmen to a sense of their own security and interest, and to vindicate the cause of right and justice. Should he fail in this, he will still have done his duty; and will leave his country, and his countrymen, with a full conviction that what the Jews were to their prophets the English are to their real inventors.

The first article gives a brief summary of what the inventor has accomplished by his twenty years' labor and great cost in removing obstacles and providing means so that that which was held to be impossible is effected. The second article illustrates and explains the practical value of these improvements for naval and marine purposes. The note is explanatory of the table, &c.

ARTICLE I.

From the course pursued against me I am induced to present the following brief summary of the result of my twenty years' labor, and append thereto a protest against the manner in which I am treated by a powerful party.

Prior to my labors in connexion with the improvement of the steam engine, which commenced in 1838, it was held as established points that the steam could not be condensed by the atmosphere, so as to render it a substitute for water where it (that is, water) could not be obtained for the purpose; that practically the expansive use of steam was not successful but in the Cornish engine, and even in that engine practice showed that beyond 50 lbs. pressure no economy was effected; that the notions entertained by me upon the expansive use of high-pressure steam were all moonshine; that such high-pressure as I proposed was not practical in the condensing engine, and dangerous in all; that strictly tubular boilers and surface condensers in water had again and again been proved to be utterly worthless, and were abandoned, and that the two-cylinder, or Woolf engine, was a useless piece of complication, which at that time was all but out of use in England. These were the views held not only by the commonality, but by the first scientific and practical authorities at that time, and propounded by the scientific periodicals.

In 1842, 1843, and 1844, I practically proved that, with air as the condensing medium, an economy equal to the Cornish engine, with its unlimited supply of cold water, could be effected; and that in place of requiring, as in the Boulton and Watt engine, 1,380 gallons of cold water per horse-power per day, 1 gallon per horse-power per day was all that was required. Further, that by means of strictly tubular boilers, properly made, and supplied with all suitable means to produce a thoroughly practical and economical result, I placed it beyond a doubt that the great bugbear—pressure, which, at that time, was said to be an insurmountable obstacle, was but a mere delusion that had no real existence, when boilers were made as sound science and correct practice dictate. I also demonstrated, thus early, that for all purposes, whether manufacturing, marine, or locomotive, the economy of the Cornish engine and boiler was obtainable, deposit prevented, sacrifice of life from explosions avoided, and a host of other practical and important objects gained; whilst, at the same time, the size and weight of engines and boilers were reduced tenfold, as compared with the Cornish, and rendered much more portable and of less weight than the locomotive, and consequently safer, and better adapted for all purposes.

In 1845 a discovery was made and published by me relating to internal cooling in the expanding cylinder when steam is used expansively, in relation to which the most unblushing falsehood is being propagated, by which Watt is made the recipient of the stolen property, contrary to the plainest import of Watt's own authenticated explanations and practice, and that universally accepted up to 1846, but the parties are not very particular, as they sometimes pass it to the credit of others, but take care always not to credit the rightful owner with it. Prior to my explanation of this matter, practice and abstract principle did not agree; the consequence was that the expansive use of steam was maintained to be of little practical value out of Cornwall, or apart from the single-acting pumping-engine. But my explanation cleared away the fog, and now superheating of steam is not, as previously employed upon the Ericsson, Stirling, and Haycraft system of enlarging the volume, but for the purpose of holding the water all in the shape of steam, from the time it enters the cylinder until it enters the condenser, whatever be the pressure and degree of expansion used. The consequence is, that practical men are now rapidly discovering that sound abstract principle and correct practice accord. To minds to whom the importance of thus having cleared away the fog upon such a question as this is admissible, and who desire only to see merit given to whom it is due, the conduct pursed by the parties in question must appear reprehensible. Dr. Haycraft, in a letter given in the "Mechanics' Magazine," dated March 12, 1850, after alluding to the universal ignorance which had existed upon this internal cooling, goes on to say—"While conversing with my brother on this subject, he remarked that he thought that the cylinder cooled by the evaporation which took place within it during the time of the vacuum, as the interior must be covered by a film of water every time the steam is admitted. The cause of the evil (says the doctor) now appeared quite clear." But it should he known that soon after I had made these views public the doctor's brother, a stranger to me, called on me at my private apartments in Birmingham, and the explanation I gave him was that the loss did take place on the side of the piston that is open to the condenser, and on the other side also, as described in my lectures at pages 47 to 50, as also pages 89 to 92.

In a long discussion in the "Engineer" a nameless correspondent, "J. B.," makes a charge against me of robbing Watt. A reply of mine will be found at page 334, volume 5. Another letter of mine, sent in time for the next week's publication, in which Watt's own account of his discoveries and views upon this head were given, was suppressed; and, strange to say, in a leader given in the same paper and same volume, at page 445, this veritable "J. B." (which, so far as anything of his personality is known to me, should be written "J. B." and Co.), is credited with the chief merit in the affair. In the last leader upon this discussion, found at page 463, are these significant hints:—"Engineers must attend to what lies next them to be done; they have to probe the action of the steam within the cylinder to satisfy themselves of the injurious precipitation and re-evaporation of the steam neutralising the efficiency of exhaustion; to apply and mature the means of preventing such condensation of the steam by the application of additional heat to the steam externally through the cylinder, or internally by superheating it; and to ensure an economically good vacuum in the condenser." Now, these are the views that for upwards of thirteen years I have been urging in the public journals and my published lectures, having also provided means and practically demonstrated for years that such views are sound and of great value in practice.

From 1842 to 1846 I practically supplied the outline of my numerous improvements in the expansive and condensing steam-engine. I was the first to practically demonstrate that steam at 100 lbs., 200 lbs., or any other pressure which does not entail too high a temperature, could be used in the condensing-engine with quite as much facility, and far more economy, than if the steam be generated at 10 lbs. only; also to show that with double cylinders on the Woolf principle the cranks could be placed at right angles, which was done in 1843, and to apply this kind of engine in a direct-acting and locomotive-like manner, whether vertical, inverted, horizontal, or in any other way, thus rendering it suited to marine or any purpose; this class of engine I have perfected in its general structure, its valves, its connecting-rod, and in the use of the crank at right angles.

In short, from 1840 to 1858, I was practically engaged, as proprietor and manufacturer, in designing, making and working my engines, boilers, and condensers, and I became so engaged because no one else would make them, or believed they could be made to any practical advantage. Seeing my position, and knowing I was right, I saw also that if the thing was to he carried out it must be by myself. The result has been, that by so doing no man living has had a more thorough practical education than I have had for eighteen years, which, upon remembering also that my engines contain not only all the principles of the Cornish, the Locomotive, and the Marine, but much that they collectively do not embody, I can despise the insinuations and tactics of those who, after having been instructed by me, seek to appropriate my inventions, and under the guise of slightly modified designs, call them their own.

If Englishmen and Scotchmen determine to reward such persons with that which is my due, yet they cannot obliterate the fact that I have produced such a mass of sound, and before they were accomplished were considered by the engineering world such difficult and impossible inventions, the practical results obtained from which were when I set out held to he utter impossibilities by all except myself, and seeing it is determined to rob me of all merit and reward, and that, too, by the foulest of means and the most unworthy agencies; seeing, also, that on the one hand a power successfully works to deprive me of all support, and on the other to give the credit to any one but me, though the ability be as low in the recipient, and the means used as unjust, as it is possible to conceive, seeing the English people seem to have no feeling for an Englishman in such case, as all this is reserved for Scotchmen, or men of any country except England. In such case I protest against such treatment, which appears to me unnatural and suicidal policy on the part of Englishmen: sinking all higher consideration. Past experience, conjoined with such impressions, produce the conviction that it is of no use my unfoldiug in detail the incredible amount of injustice with which I have been treated to a people who care for none of these things, though to them will accrue such advantages as set forth below. A strange reward mine for removing, by upwards of twenty years' labour and great cost, the physical and mental obstacles which prevented the realisation of such results. Let my enemies point out, if they can, the labours of any one man originating and maturing so much difficult and costly invention, and so instructing his fellow-creatures in a knowledge of it, at so little cost, as I have done in the face of the most powerful opposition the world can present. It is not my wish to depreciate Watt's invention, or that of any other person, but candid and well-informed men hereafter will see that his was not so comprehensive and difficult as mine, or greater in practical value, as indicated in the table given in the second article.

I have felt this statement necessary to shew that I am conscious alike of what I have done, and of the unjust treatment of which I have been made the victim. I have waited with all becoming patience, under the impression that it never could be that Englishmen would continue to look on with indifference; but seeing that they do so, and knowing the futility of one man contending against a nation, the time has come when the proper course for me, under such circumstances, is to protest against such conduct as being suicidal to the best interests of the country, at war with the laws of Providence, and most cruel and unjust towards the beings upon whom Providence bestows the powers which fit them to labour successfully in such pursuits.

ARTICLE II.

In a discussion which took place at the Institution of Civil Engineers, on the 15th and 22nd of February, 1859,† on the paper read upon Du Trembley's compound vapour and steam-engine, it is admitted that surface condensation will ultimately supersede condensation by injection. That such admission should be slow in coming can only be accounted for from the absence of practical experience with surface condensers embodying sound principles, and being properly adapted in design and mechanical detail to the requirements of practice. It is by such means, combined with the others provided by me, and indicated in the previous article, that the following practical advantages are obtained in the use of steam-power for marine and naval purposes:—

Comparative Table, with 100 lbs. pressure in my boiler and the usual pressure in the common.	Common practice.	My practice.
Cubic feet of space occupied by boilers of 500 H.P.	6,624	1,666
Cubic feet of space occupied by steam cylinders for 500 H.P.	823	312
Cooling surface of steam cylinders of 500 H.P. in square ft.	561	272
Relative heat absorbing surface of boilers to coal burnt, do.	10	45
Relative grate surface to coal burnt, ditto	2	5
*Relative full theoretic effect of 1 lb. of coal, makiug 8 lbs. of steam at 25 lbs., and having no expansion, and 1 lb. of coal, making 12 lbs. of steam at 200 lbs., and with expansion to $6\frac{1}{4}$ lbs. pressure	1	$7\frac{1}{2}$
*The same relative comparison, but with the 25 lbs. steam expanded to $12\frac{1}{2}$ lbs.	1	$4\frac{1}{2}$
Weight of 500-horse engine, in ....Tons	105	76
Weight of boiler, ditto .... ,,	78	36
Weight of water in the boiler, ditto .... ,,	48	6
Coals for fourteen days' steaming, ditto .... ,,	387	129

On an inspection of the foregoing comparison it will be seen that in a 500-horse engine, with its supply of coals for a fourteen days' voyage, the unprofitable load is reduced by 371 tons, and the paying compacity of the ship is thereby increased by that amount. What the rate per ton for goods by first-class steamers between London and New York is now, I am not aware; but during the time of the Russian war it was £6. To illustrate the case I will suppose it to be £5; at such rate the increased value of the paying tonnage amounts to the sum of £1,855 per voyage; to this must he added the value of the coal saved, which, at only £1 per ton, is equal to £258 per voyage; or the total gain upon each voyage is £2,113. If, therefore, the vessel steamed but 258 days in the year, the gain per annum is £33,808. The cost of my engines and boilers will be much less than that of the present; but if we put the cost of both kinds at £20,000 for a 500 H.P. marine engine, it is seen that the gain per annum is nearly double the cost of the engine. Thus stands the comparison as stated in the table. But the coal, which will ultimately produce the same power for the fourteen days by my boilers and engine will be nearly, if not quite, as 65 tons in place of 129 tons. Bnt to carry the mode of illustration, as given in the table to the whole marine steam power of Great Britain, including mercantile

† See The Artizan for April 1, 1859.

and naval, we may in round numbers put such power at 200,000-horse, which gives £13,523,200 sterling as the gain per annum. My opponents may take any exception they please to the above figures; but as sure as they and I exist the day is not far distant when the general practice of all maritime nations will confirm the general accuracy of my statements; and it is of the first importance to the position of the English nation, and the security and welfare of the English people, to see that they are not last in availing themselves of such improvements. It may be a light thing to such a nation to witness the injustice done to individuals; but when individuals become the representatives of mighty principles, which by them have been reduced to practice, it is not safe for England to neglect the principles nor their practical application. If the English public clearly saw the value of such things, it would rejoice that such means for extending human existence were brought within its reach. These means are of the utmost consequence for defence and attack in case of war, and of inestimable value in times of peace.

No person possessed of sound abstract views and practical knowledge of steam and its deportment, when under such circumstances as exist in our present marine steam-boilers, but must have misgivings as to the consequence of shot upon them, containing, as they do, from 40 tons to 60 tons of an explosive compound. This compound a cannon-ball may at any moment set at liberty, to the assistance of the enemy in the destruction and confusion of the crew, leaving the ship, when the steam is most required, destitute of its aid, and the crew bewildered and disabled by a mass of such matter rushing through and over every part of the vessel. Had not experience proved the reverse, I should have thought that the recommendation which my boilers possess in this particular would have been quite sufficient to have procured the most careful and candid consideration from those who are entrusted with, or in any way responsible for, the national security. An inspection of my boilers will fully bear out these remarks. But even a glance at the tables given above will show how greatly my boilers reduce this objection, as it is there seen that the explosive matter is reduced from 48 tons to 6 tons, and in addition to this, such are the facilities of subdivision that my boilers present that these 6 tons of explosive matter can with equal effect, for all desirable purposes, be divided into twenty or any number of small boilers, each acting independent of the others. In such cases, if a cannon-ball cause the liberation of the contents of one of such boilers, owing to the small quantity of explosive matter it contains, and the strictly tubular character of the boiler, the explosive matter would leave the ship merely as a squib, leaving the remaining nineteen boilers as effective as before for the use of the ship and crew. Important as are the above advantages, the following are no less so, as by these boilers and engines a ship or a fleet of ships could remain at sea under steam for a threefold time, or, what is of equal importance—and, indeed, of far greater importance under the emergency of naval warfare—it or they could, for the same time, command a threefold power, as my boilers and engines are adapted to work at any pressure and any degree of expansion, from that of 20 lbs. to that of 200 lbs. pressure. My boilers, at the same time, owing to their strictly tubular character, are incomparably more safe with steam at 200 lbs. pressure than are the present boilers with steam at 20 lbs. pressure; and the facilities they give for a varied production of steam according as emergency or economy require are everything that can be desired, as the great extent of grate and absorbing surface they provide must convince all practical and candid men.

To the foregoing recommendations are added the facilities which my boilers present for quickly getting up the steam or changing it from one pressure to another. On a comparison of the time requisite to get up the steam in my boilers compared with the present marine boilers, hours are nearly reduced to minutes, as the steam can be got up to 200 lbs. on the inch in mine before the fires are fairly alight in the present marine boiler. Many, no doubt, conclude from this that if I can so quickly get the steam up it must be unsteady in pressure in my boilers, but one day's observation of how steady and dry the steam is produced in them would convince such parties that in no boiler can these two conditions be so fully realised unless it be by the same means as I adopt. If it were required, the pressure is easily kept from varying more than 3 lbs. in 100 lbs. for the day round. The means by which this is done are very simple and self-acting, but I cannot here go into details.

If steam rams are ever found to answer for war purposes, and as gun-boats are among the most useful means by which nations wage war against each other, my engines and boilers present the very means requisite to their success, as these boilers and engines have very great power, with little weight and bulk in the machinery and coals requisite to obtain it, and the means of quickly producing this great power at the opportune moment most favourable to success. Every one of these conditions in the steam power for gun-boats is essential to success. In the discussion above referred to at the Institution of Civil Engineers, allusion is made to the leakage of the tubes in connexion with the tube plate. I have long known, from practical experience, that with iron, or any rigid and unyielding tube, it is not possible to make such joints to remain tight with straight tubes; and, therefore, I have always bent my tubes, which provides for expansion and contraction, and a continuous tight joint is the result. In this, as in other things, it has been said I am wrong; but in this, as on other points, it is I who am right, and they are wrong. Facts relating to physical laws are very stubborn things. They will remain a hundred years hence what they were fifteen years ago.

A recently published abstract of a paper read at the Liverpool Literary and Mechanics' Institute, relating to the steam-ship *Thetis*—the subject of which is a good illustration of the morality the patent laws engender, and the inverted purposes they are used for. This ship *Thetis* is the same vessel that the experiments related by me in the "Engineer" of the 4th of December, 1857, were made in, and in which were made those authenticated by Professor Rankin, and found in the discussion above alluded to at the Society of Civil Engineers, an abstract of which will be found in The Artizan for April 1, 1859; and also from more recent numbers of The Artizan, we find that Professor Rankin states the economy to be as 1·018 lbs. of coal per horse-power per hour, and the account we have from the Liverpool Institute states that from several trips between Glasgow and Liverpool, the actual practical result is, that 3 tons 12 cwt. of coal does the work for which 20 tons are required upon the common practice. What I have stated, from my own experience, I know to be correct, and that it is borne out and confirmed by eighteen years' practice. And the same long practice assures me that the so-called improvements of Rowan and Co. are detractions from my original inventions, of which the so-called inventions are an attempted evasion.

Note.—The only remarks explanatory of the table necessary, in addition to that given with it, is that the average quantity of water evaporated by each 1 lb. of coal in the common marine boiler is 8 lbs., and that in my boiler 1 lb. of coal evaporates 12 lbs. of water. The force referred to as that due to 1 lb. of coal is the whole force inherent in the 8 lbs. and 12 lbs. of steam respectively, when generated and examined under the conditions there stated. If any object to those conditions, let them adopt any other sound method, and much the same result will ensue. I have not put the expansion of the 25 lbs. steam at more than half-stroke, as, with such low pressure, I know there is no good practically in doing so for marine purposes. If the 8 lbs. of steam be represented by 1—in the first case without expansion—then the gain, as shown by the 12 lbs. of steam, is seven and a-half fold, when referred back to the 1 lb. of coal used in each case; and in the second instance the gain by the 12 lbs. of steam is four and a-half fold. The cylinder capacity in cubic feet includes that circumscribed by top and bottom flanges, both in the common engine and my own; and the relative capacity of the interior bears the same proportion. All the figures in the above table, except those marked *, are based upon actual practice. These refer to the abstract properties of steam, and are placed before the reader in order that he might see how far short the practical results I attribute to my engines and boilers, as set down in the table, are below what a correct statement of the relative abstract resources warrant us in believing my practice can attain to. Eighteen years' practical experience assures me that, with my engines and boilers well made and managed as Mr. Penn's engines and boilers are now made and managed, that they will, as marine engines, not require even 1 lb. of coal per horse power per hour. Should any be curious to know what my views were of Du Trembley's compound steam and vapour engine upwards of fourteen years ago, they will find them stated from pages 42 to 45 of my lectures. All the reasons upon which I then knew it had no practical value equal to the extra cost—except in the wasteful mode of using steam hitherto practised in marine engines—have become stronger now. Let steam and the steam-engine have justice done to them, and we shall hear no more of the compound steam and vapour engine.

REVIEWS AND NOTICES OF BOOKS.

Chart of Naval History. 1859. By Frederick Perigal. London: J. D. Potter, Poultry.

This is a sheet compiled from historical publications, old reports, Parliamentary returns, and other authorities, of the various events connected with the naval history of Great Britain, commencing in the last century B.C. down to the year 1857. It is the first attempt which we remember to have seen, of collecting and publishing, in the form of a chart, a comprehensive record of events in the naval history of Great Britain, and we hope that ere the next edition is issued—and we think it will not be long before another edition is called for—many of the spaces or blanks which now exist will be filled up with interesting details, and the interest belonging to much that has already been collected may be increased.

Mr. Perigal deserves great credit for the manner in which he has produced this first edition, and we hope that the publication will receive the extent of support to which it is fairly entitled.

The Shrapnel Shell in England and Belgium, &c. By Major-General Bormann. London: Trübner and Co., 1859. pp. 166.

The author devotes one hundred and one pages, of twenty-four chapters or divisions, to descriptions of the various kinds of projectiles in use, particularly those of the Shrapnel order, as used in various countries; and he treats the subject in a thoroughly practical military style.

About thirty-six pages are devoted to nine notes, which must possess considerable interest for the scientific artillerist; and an appendix of ten pages first offers some remarks on the efficacy of the Hanoverian Shrapnel fire in the Schleswig-Holstein war, by a Danish artillery officer; second, the use of English spherical case-shot at the siege of Sebastopol, as described in Colonel Hamley's work; third, the German *Hagelkugel*.

Extract from the "Codex Palatinus," at the University of Heidelburg.—"Altogether the work possesses considerable interest, and exhibits the great love of his profession possessed by Major-General Bormann. The work will be found to be a very useful addition to the now numerous handbooks connected with the machinery and *materiale* of war.

The Carpenter's and Joiner's Assistant. Blackie and Son, Glasgow, Edinburgh, and London. Parts 19 and 20.

We have already, on several occasions, noticed this work in terms of high praise, but while praising the excellence of the copper-plate illustrations, as well as the selection of the textual matter and subjects treated of, we cannot too strongly call attention to the not only good faith of the publishers, but to their great liberality and painstaking devotion to the securing for the work thorough excellence and completeness; for as the publication of the work draws near a close it becomes more evident that those who may hereafter be bold enough to undertake a new work upon Constructive Carpentry and Joinery will have no easy task to perform to approach the degree of excellence which Messrs. Blackie and Son have imparted to the present work.

Description of a Breakwater at the Port of Blyth; and of Improvements in Breakwaters, applicable to Harbours of Refuge. By Michael Scott, M. Inst. C.E.; with an Abstract of the Discussion upon the Paper. Edited by Charles Manby, F.R.S., M. Inst. C.E., and James Forrest, Assoc. Inst. C.E., Assistant Sec. London, 1859.

This is a re-publication, in a complete form, accompanied by three large plates, illustrating the Paper, by Mr. Scott, read December 7th, 1858, at the Institution of Civil Engineers, and gives *in extenso* the very long and interesting discussion which took place on the following evenings. An abstract of the paper and discussion, which occupied five evenings, has been given in The Artizan, which circumstance renders it unnecessary for us to do more than notice the publication of the paper and discussion in a collective form, and to add, that a reference to the work will be found useful by very many of the young aspiring engineers, who hope some day very soon to be employed upon such like works.

Accompanying this work we find published, in Parliamentary Report shape, some nine pages of observations "On Certain Portions of the Reports of the Royal Commission on Harbours of Refuge," by Michael Scott, C.E., in which Mr. Scott falls foul of the Commissioners, and analyses portions of their report; *prima facia,* we should say the two concluding paragraphs on page 12 fully bear out Mr. Scott's views upon the subject, and exhibit the very loose way in which Parliamentary returns relating to public works are allowed to pass.

LIST OF NEW BOOKS AND NEW EDITIONS OF BOOKS.

BORMANN (Major-General.)—The Shrapnel Shell in England and in Belgium; with some Reflections on the use of this Projectile in the late Crimean War: a Historico-Technical Sketch. By Major-General Bormann. 8vo, pp. 166, cloth, 7s. 6d. (Trübner).

BURGOYNE (J.)—The Military Opinions of General Sir John Burgoyne. Collected and edited by Captain the Hon. George Wrottesley. 8vo, pp. 480, cloth, 14s. (Bentley.)

FULLER (G. L.)—Ship Lifts *v.* Dry Docks: a Descriptive Account of Mackelcan's Patent Ship Lifts, a cheap and efficient Substitute for a Graving or Dry Dock; with an Illustration. 8vo, 6d. (Richardson.)

GLOVER (F. R.)—The Polymeter, or Quintant; a Practice of a new Sector as used in Trigonometry, &c. 12mo, cloth, 2s. 6d. (Bell.)

GREGORY'S (I.)—Military Map of the War, showing the Position of the Hostile Armies. 12mo, case, 1s. (Simpkin.)

HERSCHEL (J. F. W.)—A Manual of Scientific Inquiry. Prepared for the use of Officers in Her Majesty's Navy and Travellers in General. Originally edited by Sir J. F. W. Herschel. 3d edit., superintended by the Rev. Robert Main. Post 8vo, pp. 438, cloth, 9s. (Murray.)

HITCHCOCK (E.)—The Religion of Geology and its connected Sciences. By Edward Hitchcock. New edit., with an additional Lecture, giving a Summary of the Author's present Views of the whole Subject. 12mo, pp. 370, cloth, 2s. (J. Blackwood.)

KING (J. W.)—Continental Europe from 1792—1859. By J. W. King. 12mo, pp. 286, boards, 2s.; cloth, 2s. 6d. (Knight.)

MATHEMATICS.—Useful Formulæ, chiefly in the Pure Mathematics. For the use of Candidates preparing for Addiscombe, Sandhurst, Woolwich, and the Universities. To be committed to Memory. 12mo, pp. 15, sewed, 2s. (Whittaker.)

MEASOM (G.)—The Official Illustrated Guide to the Lancaster and Carlisle, Edinburgh and Glasgow, and Caledonian Railways; including Descriptions of the most important Manufactories in the large towns on the Lines. Post 8vo, pp. 400, sewed, 1s.; also Official Guide to the North-Western Railway (including the Chester and Holyhead Line) and their Branches. 12mo, pp. 760, sewed, 1s. (W. H. Smith.)

NEWTH (S.)—Mathematical Examples: a Graduated Series of Elementary Examples in Arithmetic, Algebra, Logarithms, Trigonometry, and Mechanics. Post 8vo, pp. 380, cloth, 8s. 6d. Mechanical Example. Post 8vo, cloth, 2s. 6d. Trigonometrical Examples. Post 8vo, cloth, 2s. 6d. (Walton.)

NORTHCOTE (J. S.)—The Roman Catacombs. By Spencer Northcote. 2d edit., 12mo, cloth, 4s. 6d. (Dolman.)

SIMMS (F. W.)—Practical Tunnelling; explaining in detail the setting out of the Works, Shaft-sinking and Heading, Driving, Ranging the Lines, and Levelling underground, Sub-excavating, Timbering, and the Construction of, the Brickwork of Tunnels: with the amount of Labour required for, and the Costs of the various portions of the Work, as exemplified by the particulars of Blechingley and Saltwood Tunnels. Imperial 8vo, pp. 200, cloth, 21s. (Batsford.)

STEVENS (R. W.)—On the Stowage of Ships, and their Cargoes, Freights, Charter-Parties, &c. 2d edit., 8vo, pp. 316, cloth, 7s.

TOMLINSON (C.)—The Thunderstorm: an Account of the Propgrties of Lightning and of Atmospheric Electricity in various Parts of the World. 12mo, pp. 360, cloth, 3s. 6d. (Ch. K. Soc.)

WHITE (H.)—Guide to Civil Service: containing Examination Papers, Lists of Public Offices, Qualifications, Salaries, and all necessary information for those seeking Government Appointments. 3d edit., greatly improved, post 8vo, pp. 160, cloth, 2s. 6d. (P. S. King.)

WHITE (J.)—On Health, as depending on the Condition of Air; and on a Patent Process for the Purification of Air. By J. White, M.R.C.S. 8vo, sewed, 1s. (Hamilton.)

CORRESPONDENCE.

[*We do not hold ourselves responsible for the opinions of our Correspondents.*—Ed.]

BOILER CLEANSING.

To the Editor of The Artizan.

Sir,—As the following little experiment may be of use to some of your readers, you will oblige by kindly giving it a small space in your valuable Journal. One day having occasion to boil some lemon grass in an iron kettle, I was astonished, on pouring out the water, to find that it had quite cleaned the kettle, removing all the sediment that adheres against the inner surface thereof. I subsequently tried the effect of the same material on a high-pressure tubular boiler of H.M. gunboat, the *Benares,* in the N.W. Provinces, and found it had produced the same beneficial effect, and I had only to take the precaution of renewing the lemon grass once in two weeks, and blowing off every night when at anchor; and to prevent the grass getting into the cocks, I made a box, 26 in. × 14 in. × 8 in., perforated with holes, in which I used to put the grass, and place it in the boiler. This experiment was tried in fresh water, but rather muddy, and, what is more, in the height of the freshets it contained mud and sand in the proportion of 1 to 3; in every case it was satisfactory.

Yours obediently,

Calcutta, May 31, 1859. W. A. Dul (an East Indian).

INVENTORS AND MANUFACTURERS.

To the Editor of The Artizan.

Sir,—It has been well said, that "To be a statesman and legislator a man must have sympathies with all causes, interests, and classes, and represent in his own person the heterogeneous materials of this very composite country." Upon the same principle you, Mr. Editor, should have sympathies with all causes which tend to the permanent advancement of the arts of life. Impressed with these truths, I have ventured to send you the results of my experience and reflections on a very interesting and most important subject.

"He who has the happiness to see objects of any description with greater perspicacity than his contemporaries, and presumes to disseminate his superior knowledge by the unreserved publication of his opinions, sets himself up as a common mark for the shafts of envy and resentment to pierce." Such is, of necessity, the unfortunate position of meritorious inventors; and the greatest punishment frequently falls on those whose inventions are of the greatest benefit to mankind. The Ephesians, with republican pride, banished to some other state the citizen who presumed to excel the generality of his countrymen; and meritorious inventors, now a days, are frequently deserted by their friends and left to struggle in solitude and in poverty to develope their plans. And to add to their deluded hopes, the present patent-law, in most cases, is good for nothing—worse than nothing—a delusion and a snare. Whoever suggested and framed such a law, must have had an eye to the multiplication of patents, and not to the permanent advancement of the arts of life. Instead of taxing patents according to their income or value, an arbitary attempt has been made to extract something out of nothing, or much out of little; thus, in most cases, the Government fees have not been paid, the pateut lost, and the inventor sacrificed. This is a state of things which ought not to be allowed to exist in a country which owes so much to its inventors.

But in acknowledging the claims of meritorious inventors, and the urgent necessity of some change, I do not undervalue the great services of those who successfully apply the inventions of others to the arts of life for the public good. These men, however, like the monarchs of the forest, take care to appropriate to themselves the lion's share, and compel inventors to bide their time, frequently starving them out—so to speak—in the midst of plenty. By this bad system, not only is the poor struggling inventor deprived of the fruits of his labour, but the public is also. A period arrives, sooner or later, when these great establishments are compelled to make great sacrifices for which they, in their turn, receive no compensation nor consideration from the public. If the plague ended here it would not be so fatal, but it unfortunately spreads into the happy homes of poorer tradesmen and artizans, inoculating men, women, and children, and replenishing the country with avarice, deceit, poverty, disease, and crime. The *Times* (May 22, 1847) states that the poor-rates in Nottingham were 9d. per head in 1764, and 8s. 6d. per head in 1842! Again, the *Times* in a leading article, exclaims—"Crime is not diminishing throughout the country. In our own day acts are perpetrated as foul, as horrible, as cruel, and as monstrous as ever darkened the ages of the grossest barbarism and the most savage ignorance." It is here where a great difficulty really exists. This is the monster we must teach our children and our grandchildren to grapple with. *It is the problem to solve,*—in fact, it is the finest problem of the age to solve.

The *Times* has lately said—"Let no man despise a vested interest, however small, or its possessor, however humble, obscure, or foolish. Men will fight for their own, and fierce is the conflict when the public storms the citadel of self-interest." Thus, for want of a just law to stimulate, and also to regulate inventions, an incessant warfare is kept up between the old and new order of things. But there is an eternal inherent law in Nature which compensates and conserves. In the universe, the sun, in all his splendour and sublimity, keeps the planets in check, affording and receiving compensation. But in society, for want of a governor and a balance, the eccentric machinery of the nation goes by fits and starts—first destroying one interest and then another, which makes it unsafe to invest the savings of labour in any business or patent. It is hard to say who will escape injury in such a ruinous scramble. Let him who thinketh he standeth take heed lest he fall. Now, with all due deference, I beg to ask inventors and manufacturers, noblemen and workmen, the rich and the poor, the statesman and legislator, to think seriously on these things, for it is labour in vain to attempt any scheme of improvement or progress without property is respected, and the fruits of labour secured.

The ancient and modern customs of deifying inventors after they are dead and gone may satisfy some men's minds, but it is poor stuff for their bodies while struggling to develope their plans. If property in patents was by law divided into two parts—one part for those whose property and trades would be rendered useless by the invention, and one part for the patentee—society at large would be greatly benefited by thus allowing inventions to progress. By these means, or by any other kind of arrangement and division of rights, no one need be injured by the rapid progress of inventions; and human nature would be freed from a degrading and demoralizing influence—a matter of infinite importance. Pray let it not be said that it is impracticable, for where there's a will there's a way. The greatest sage in modern times has said that "a man's trade is his estate." The Emperor Napoleon III. admits the principle of compensation into the social compact. "Some must be stimulated, others kept in check. Hence the necessity, without stopping progress, of assisting those who cannot keep up with its accelerated movement." But great inventors, as it is now and ever has been, and ever will be if the preseut immoral state of things exist, frequently eke out a miserable life. This is not all—and, it cannot be too often repeated—society at large is not permitted to enjoy the fruits of their labours till the first, second, or third generation have passed away, and not even then without further sacrifices and victims. There are petty inventions, and there are exceptions, but this is the rule.

The *Times,* in a very important leading article (February 11th, 1856) on the Limited Liability Act, has emphatically remarked—"We conceive that we are breaking no law, betraying no order, if we hold that there is a vast amount of personal merit and personal capacity which might have a better chance under better laws. We have heard it said by one who was himself beholden to nobody for his position, that three things were necessary to success—power, perseverance, and patronage; and though patronage in its proper sense must ever be an accident, it is the duty of the State to supply it by equal and fostering laws." It was thought that the Limited Liability Act would, to a great extent, aid and assist inventors, and enable us to progress; but the want of the compensating principle, and of honest men devoted to the cause of progress, have rendered it a dead letter; and if some proper stimulant is not administered, inventions and patents in this country cannot keep pace with the accelerated movement of other nations. Our manufacturers, one by one, tell us, *"I have no faith in the office."* And thus all patents are suspected and abhorred.

To sum up: inventions and labour-saving machines ought to be encouraged, but society should not be disturbed without just and wise compensations. This is indeed the finest problem of the age to solve. It is the granite base of the whole superstructure. "Do unto others as you would they should do unto you." "Live and let live." Adopt this inherent natural principle of compensation and conservation as a base of operations, then will moral and physical science progress rapidly together—then will the greatest blot in the nineteenth century be obliterated from society. HENRY PRATT.

OMISSIONS AND PREJUDICES.

To the Editor of THE ARTIZAN.

SIR,—Great discoveries as well as great disasters frequently grow out of trifles. The fall of an apple suggested a sublime idea; the want of a road destroyed an army. Our greatest men, at times, make serious omissions, and are surrounded by sad prejudices. Newton and Watt, in their two greatest discoveries, were "puzzled," and Bacon, blinded by prejudices, opposed the Copernican system, in spite of the mechanical philosophy of Galileo and the analogous system of Pythagoras.

About a century and a half had passed away before the true cause of Newton's discovery was explained by Sir Richard Phillips upon mechanical principles.

"In 1665, Newton, then in his 22nd year, and a student at Cambridge, saw an apple fall from a tree, and speculating on the cause, conceived it arose from the earth's attraction. He then imagined that the earth retained the moon in its orbit by the same power, and the sun the planets, and called it universal gravitation or weight. He then supposed it to emanate like an odour, or heat inversely as the *square* of the distance. But as attraction causes the approach of bodies, and the moons do not fall to their primaries, nor the planets to the sun, he ascribed to revolving bodies a projectile force to counteract the other at right angles. This is the Newtonian philosophy, built step by step on gratuitous hypothesis.

"About 1805 it occurred to Sir Richard Phillips that, as the fall of bodies is a mere phenomenon of *motion* on a *moving* globe, itself subject to two motions, so any variance in the direction of these would, as in all such cases, produce an *increase* of velocity in a body surrendered to their free action; and the direction to the centre would be likely to be the constant diagonal of both. It would fill a volume to describe the difficulties which attended the development of this simple problem, and the opposition which the attempt raised in writers and teachers who were committed to the previous mysteries. No one had attended even to the quantities of these motions, and there was a complication in them which for years baffled satisfactory conclusions."

"However, we now have these quantities very nearly, but they have not been investigated with any view to the major problem in question. The motion of the fall of a body is not, in any school in 1839, regarded as a sequence of the earth's two motions."

For the theory and the proof see the "Million of Facts," col. 398.

"No other proof resembles this in the whole circle of natural philosophy; and no phenomena, not involved in the earth's local motions, can be ascribed to the same cause as the cause of the fall of an apple."

About a quarter of a century after the death of Watt, the *cause* of the loss of heat, which "puzzled" the great engineer, was explained by Craddock, proving that Watt had not carried the principle contained in his separate condenser far enough; and even Craddock omitted to make the best use of his discovery. For, notwithstanding it was well known to engineers that there was a difference of 30 per cent. between cranked engines and direct pumping-engines, *no one* ever thought of cutting off the condenser from the cylinder one-third of the time, so as to be on a par with the pumping-engine, and thus stop the heat from going into the condenser. But sadder still, notwithstanding several letters and illustrations which were sent to the Admiralty in 1857 notifying these omissions, the engineers refused to entertain the matter, or condescend to discuss the subject. What omissions and prejudices! What obstacles inventors have to surmount.

In March, 1857, I was pursuaded to submit my double air-pump to the Admiralty, it being applicable to surface condensers and to very quick speeds. I did so, and not succeeding, I have since hawked it about with the two plans of cutting off, and lots of other things, without any success or patronage.

On the 18th and 24th of April, 1857, I addressed two letters to the Admiralty, one of which I thought at the time contained an important discovery; but I ascertained some months after that Mr. Craddock had made the same discovery ten years before! However, the idea of cutting off was still original, and being desirous of making some impression, I addressed a third letter to the Admiralty on the 24th of December, in the same year, from which I extract the following:—

"We hear of Cornish pumping-engines doing extraordinary duty, but these steam-engines act direct, and their piston-rods are not controlled by the rotary motion of a crank. The consequence is, that in crank-engines about *one-third* more time is allowed for internal radiation; and this serious loss happens while the crank-pin is exerting little power, and the internal radiation is at its maximum. The plain, simple remedy, then, is to shut off the condenser from the cylinder and piston during this period, so as to reduce the time about a third. By this contrivance the piston may work with a constant good vacuum in a surface condenser, and with less loss from internal radiation. And it should be remembered that, while the engine is feeding on itself, about one-third of the time, so to speak, it is still doing duty, and preparing for the return of the piston in an easy manner. A vacuum of 29·5 in. of mercury would exert a chilling effect on the cylinder and piston; but when the interior of the cylinder about equals the vacuum in the condenser, it is shut off, and the *difference* of pressure and heat on each side of the piston becomes less and less till the return of the stroke."

London, July 14th, 1859. HENRY PRATT.

NOTE.—Mr. Craddock thinks that we make use of a wrong expression, as radiation ought not to be applied to denote the loss of heat in question, but conduction. It is true also that some marine engineers have cut off pretty freely from the condenser, not with a view of saving steam or solving the problem in question, but to break the blow; and thus it may be said by some that there is nothing new in this, as I have again been anticipated. Be this as it may, I see no objection, if it can be conveniently done, to cut off from the condenser when you cut off from the boiler—namely, when the piston has passed two-thirds of the stroke. This will not only give time for the boiler and for the condenser to recover themselves, but will furnish sufficient water to lubricate the working parts, and, with heated covers, &c., will save much steam. H. P.

HIGH PRESSURE, CUT-OFF, EXPANSION, &c.

SIR,—Mr. Craddock is crying out most bitterly against the proscription he has endured for eighteen years past, and is making "his last effort to vindicate the cause of truth and justice" by private appeals to his countrymen.

An inventor's life is at best a life of anxiety and misery, and frequently degraded and demoralised by poverty and crime. Vested interests attack him, and the laws do not protect him. Upon the authority of the "Times" we ask the question—"Can it be said that the legislature does patronise obscure talent and humble industry, when it is rare to see either succeed, and when the laws seem to assume every inventor crazy, and every trader dishonest?" In a list of the recognised improvements of the stocking frame, published now thirty years ago, out of forty names half have come to misery and degradation, to the gaol, to transportation, or the gallows; and one had been hung and beheaded for a traitor. A man in these days must find a friend—and a very good friend—if he would turn the genius of Watt to any account: but such a friend is not often to be found.

About the end of the last century an attorney in a midland county, known for his ability and uprightness, was told one day that a man wanted to see him. On going into his hall he found a mechanic, who said he had an improvement in some branch of manufacture, and he wanted some assistance to carry it out: he was from a neighbouring county, and had only heard of the attorney through some accidental channel. Such applications are not uncommon in the manufacturing districts, and are seldom attended to. In this case the attorney was taken with the man's appearance, gave an attentive hearing to his story, thought there was something in the invention, advanced some money, and lent more and more, eventually to the utmost of his means. He was not ruined: on the contrary, the mechanic became the founder of one of the richest families in England, and the attorney was enriched by the connection. Had the attorney not been able to tell a good man when he saw him, or to form an opinion of the invention,—had he even not been at home, or not in a condition to lend money, the mechanic would probably have shared the fate of a thousand others—lived to see his improvements generally adopted, and finished his days in a workhouse. It may be said the example shows what may be done under our existing laws, nay, under worse laws, perhaps, than now exist; but it was an accident, and the attorney was justly proud of having made a man and a family.

Now, without going into the mass of matter which the printed papers before us illustrate, let us remind our readers that Mr. Craddock's inventions and labours may be summed up into four very important discoveries.

1st. His atmospheric condenser, perfected in 1844.

2nd. His strictly tubular boiler, suggested in 1842, and worked out in 1846.

3rd. His revival of the Woolf principle, and his placing the cranks at right angles at the same time, as arranged in 1843.

4th. His important discovery in 1845 of the true cause relating to internal cooling in the cylinder when steam is used expansively.

Notwithstanding these important inventions, success has not attended his honest efforts and resolves. There has been a blank in the chapter of accidents, for he was not lucky enough to "find a friend." Without counting the cost, he became a proprietor and manufacturer of his own engines, because, as he says, "no one else would make them." Consequently, born too soon, and worked too hard, he must have had a world of difficulties to contend with, especially in a smart progressive age like this, where honesty is not thought of, and where success alone is considered everything. In fact, I quote from the latest and the highest authority in this country. "The world does not like people who are outwitted and illused. It greatly prefers the man who does a clever thing, who makes a judicious use of his patronage or his money, and who gets the day some how or other, by fair means or by foul. People don't care much for a fox, or a hare, or for anything, indeed, except the world, the flesh, and the devil." And if we turn to the columns of the "New York Journal of Commerce" for June, 1845, we shall see our children in America portrayed in a similar manner. "We want, wherever we see a head, to break it; wherever a heart beats, to stop it; wherever there is beauty, to deform it; and wherever there is order, to bring in chaos. We can't bear these restraints which are called civilization. This is mine, and that is yours. We want to own nothing, and to rob for everything. This world has swung out of its orbit, and come too near to what they call heaven. We want to swing it as far the other way, until it comes hard by, if not all over in, the infernal regions."

Alas! how shocking are these modern opinions when contrasted with the opinions of the ancients and of our ancestors! When a great sage, 600 B.C., was asked the question, "In what do we resemble the gods?" he replied, "In doing good, and speaking the truth." And there never was a line more honourable to human nature than the following, in Pope's "Essay on Man:"—

"An honest man is the noblest work of God."

Let us act on these God-like principles, and then we shall do justice to Mr. Craddock and his contemporaries.

I am, &c. * * *

BOILER ECONOMY.

To the Editor of The Artizan.

Sir,—As I was much pleased with the remarks in the current number of The Artizan on "Steam Generation," as being the most common-sense I have yet seen on the question, I send you the enclosed letter, addressed to the "Newcastle Chronicle," as a proof that, with attention to the boilers *alone*, a very large increase of economy can be obtained. In the engines of these two steamers, I could not make the changes I desired, their original construction precluding this. I feel satisfied that if I could have altered them to my own views, a very considerable increase of economy would have been obtained. There is enough to show that boilers have been sadly neglected in their construction, and that the tubular system is not the wretched bad thing some would have us to believe.

I am, dear Sir, yours truly,
George W. Jaffrey.

Hartlepool Iron Works, Hartlepool, 4th July, 1859.

To the Editor of the "Daily Chronicle."

Sir,—In the latter end of last year some correspondence appeared in your pages upon the merits of north country *versus* Welsh coals, which, instead of being confined to the question mooted, was, through the Billingsgate propensity of one of your correspondents, abruptly terminated, because the writer believed no practical fact could ever be demonstrated if it was made the vehicle of personal attack.

What I wished last year to show was, that with boilers properly constructed steam-ship owners would find that north country coal is very much superior to Welsh for all sea-going purposes, and that in the great majority of boilers now in use, a very large proportion of the primary elements of the fuel is wasted and rendered destructive to the boilers, instead of generating steam. In illustration and further confirmation of these statements, I beg to give you the results obtained from two new boilers we have lately fitted on board steamers—the *Countess of Durham* and *Viscount Lambton*. The former boilers in both ships had only been in use for three years, and could not be called old; and that there may be no room for cavil or doubt, I give you an extract from a letter received from the Earl of Durham's engineer, Mr. R. P. Clark, who writes thus:—

"The consumption of coals in the *Countess of Durham's* old boiler for the average of four voyages, was 58½ tons per London voyage, with new boiler it is about 39 tons per voyage; but with the last alteration of bars, which has hardly been fairly tested yet, having only gone one voyage since, I expect the consumption will be below 39 tons per London voyage. The captain of the *Viscount* says his consumption with old boilers was 68 tons per London voyage; with the new boiler it is 35¾ tons per London voyage."

In reference to this last it is but right to say that the principle of superheating steam was carried to a larger extent in this steamer than in the *Countess of Durham*, and to that, as well as being fitted with an improved form of propeller, must be given a share of the increased economy obtained. In both these new boilers, I may remark that the fuel is consumed without the production of smoke.

Much has been said about the enormous expense attending screw colliers and screw steam-ships generally, but if we are to take the above as a specimen of the manner in which fuel has been thrown to the winds, simply from the fact that boilers have been constructed upon a false principle in detail, and if by the above fact such a direct amount of economy can be obtained by the substitution of correct principles to their construction, independent of the indirect and collateral saving, I may be pardoned for saying that steamship owners need not despair of making this kind of property both a profitable and satisfactory investment. Should you deem these remarks of any public utility, perhaps you may find room for them in an early impression.

Geo. W. Jaffrey.

Hartlepool Iron Works, June 29, 1859.

NOTICES TO CORRESPONDENTS.

P. Z.—The idea is not new. A Steam Boiler Insurance Company has been established for some time past in Manchester, and we believe with considerable success. Had you been, as you sign yourself, a constant reader, you ought to have observed mention made of the Manchester Association several months ago; and on reference to the wrapper for April and May last, you will find an advertisement relating to the Manchester Steam Boiler Insurance Company. We never heard of a Mines' Insurance Company. What are the proprietors of mines to insure against—fire, explosions, inundations, and loss of life and property from those causes, and for the delay and loss of profits whilst the mines are cut of work?

A Kentish Subscriber.—There are but two, or at the most three, engineers on the Thames who will take apprentices, and the premiums required by them are, we understand, £500 and upwards. You had, however, better apply to each of the marine engineers by letter, and ascertain for yourself. Should you not succeed in obtaining what you require, amongst them, we suggest that you should make interest, and obtain employment in the Steam Factories at Portsmouth or Woolwich.

S. P.—We are not aware of the existence of any such patent right. You must be in error. It is possible there may be some invention in the particular preparation employed to dress the tracing paper, and that that is the subject of the claim or claims; but it is certain that our draftsmen, and hundreds of others, have employed tracing transfer paper for several years past for taking transfers by one operation from the original drawing, or a tracing thereof, for the stone or zinc.

J. V. P.—(Comparison of *Bremen* with *Victoria and Albert* and *Himalaya*).—We shall be happy to furnish you with further information, by post, if you will forward to us your address, but we cannot afford the requisite space for the discussion of those subjects at length. We are glad to receive facts connected with steam-ship performance from whatever source they may come. We furnished you in our last number with the comparisons you asked for, and we gave them without comment, and they have produced the following letter disputing their accuracy, and we are asked in fairness to give it insertion:—

"Greenwich, 14th July, 1859.

"Sir,—In The Artizan for last month, comparison is made of the performance of the *Bremen* with the Queen's yacht *Victoria and Albert* and the *Himalaya*.

"In this comparison the indicated power of *Bremen* is not correctly given, which makes her appear as a failure; the power indicated being 1,624, and not 3,516, as stated in The Artizan.

"A full report of her construction, engine power, and dynamic performance, has been published by the Committee appointed by the British Association of Shipping Statistics, which may be referred to. "I am, Sir, your obedient servant,

"David Rowan,

"To the Editor of The Artizan." "Caird & Co."

T.—We regret that pressing matters have deferred the reply to our correspondent's inquiry. If as stated, fuel is of no object for a small steamer, a cylindrical boiler would probably be the least expensive, one of 8 ft. diameter, and 8 ft. long, with two 2 ft. furnaces, and grates 5 ft., return tubes 3¼ in. outside drain, and 5 ft. long; such a boiler would have about 400 ft. heating surface, and would supply about 21,000 cubic ft. of steam of 30 lbs. per square inch above the atmosphere per hour, which is the pressure we would advise in your case; such a boiler will be far from economical in fuel. You inquire as to the prospects of surface condensation; in reply, we can only express our conviction, that permanent practical success is certain; it is only a matter of time.

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c.

Under this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.—Ed.

Enamelled Slate.—In the Common Pleas, 28th June ult., in an action (Magnus *v.* Pitts and another) for libel, the plaintiff, who is the proprietor of the Pimlico Slate Works, and the inventor of enamelled slate (an article used, among other things, for billiard-tables, sued for damages as against the defendants, who are the successors in business of a well-known firm of billiard-table makers, and who had advertised the superiority of their tables over those made of the enamelled slate, one of which latter (supplied to Her Majesty at Osborne) had been, as they stated in their advertisement, superseded by one made, by command of Her Majesty, by the defendants. A similar—as alleged—libellous statement had also been made respecting the enamelled slate table supplied to the Duke of Wellington. Special damage was alleged, and in proof of it, two gentlemen were called, who had intended, each, to order a table of the plaintiff, but forebore to do so, in consequence of havingseen the defendants' advertisement. The Jury found for the plaintiff—damages, £75; of which, £25 was for the special damage.

Tunnel Driving (for Metropolitan Sewerage).—In the Vice-Chancellors' Court, 6th July ult., before Sir W. P. Wood, the North London Railway Company as plaintiffs, made a motion as against the defendants, the Metropolitan Board of Works, to restrain the latter from continuing their line of sewers by a tunnel under a portion of the Company's land, not comprised in the usual notice of intention to purchase. The land described in the notice terminated abruptly in the middle of a field belonging to the Company. The Board, for their main-drainage works at Bow, proposed to continue their sewer by a tunnel under the remaining portion of the Company's land, not comprised in the notice. To this, however, the Company objected; and hence the application to stay the tunnel operations until the Board of Works should have complied with the provisions of the Land Clauses Consolidation Act of 1845. The Vice-Chancellor held that, looking at the subject-matter of the Metropolis Local Management Act, which was for the benefit of the public and of the whole community, it was perfectly legitimate for the defendants to say that these large powers (granted them by the Act) could not be measured by the more guarded nature of the powers conferred on railway companies and the like. The whole scheme for draining the metropolis might be entirely stopped, if section 135 were limited, in the way proposed by the plaintiffs, and he had no hesitation in coming to the clear conclusion that it was not so limited. The motion must therefore be refused; but it was hardly a case for costs.

Anchorage and Beacon Dues.—Liability to Poor Rates.—The Court of Queen's Bench (2nd July ult.) decided that dues of this description are subject to be rated for the poor. This was a special case on appeal, argued last term, and the point to be decided was (overseers of Bishop Wearmouth, respondents; the Earl of Durham, appellant) whether certain tolls, leviable on all ships entering the Port of Sunderland, and going up the river Wear, as anchorage and beaconage dues, and payable to the Earl of Durham, as lessee of the Bishop of Durham, were properly rated for the poor. The court now held that the tolls were not tolls in gross, but were tolls connected with the use and occupation of the soil, and were somewhat of the nature of dock-dues. They must be considered as payable, *ratione soli* (on account of the land), and therefore were properly rateable. Judgment, accordingly for the respondents.

Railway Accidents.—Compensation.—In the long-pending and much-debated case of Smith *v.* the Great Northern Railway Company, the Jury (Queen's Bench, sittings at Nisi Prius, at Guildhall, 2nd July ult.) returned a verdict for the Company. This was the sixth time the issue between the parties has been tried, but the first, in which the Company had obtained a verdict: the plaintiff therefore applied to stay execution for the costs. The Lord Chief Justice, in refusing the application, as he stated himself to be in strictness bound to do, remarked that he was quite sure, considering that this poor man (the plaintiff) had been greatly injured, the Company would deal with him in a merciful spirit, and not compel him to pay their costs. To this suggestion the Company's Counsel intimated his clients' willingness to accede.

In another Compensation for Railway Accident case (Wright *v.* North Eastern Railway Company, Court of Common Pleas, 2nd July ult.), the plaintiff, a widow lady, on the 24th August, 1857, booked herself through, from Edinburgh to Doncaster, as a first-class passenger by the mail train. On approaching York the junction is on a curve, so that the ordinary signals could not be used, and the only warning of the approach of a train was the ringing of a bell. At this point, the train ran into a truck, which was being shunted, and plaintiff was thrown upon the floor of the carriage (when she was sitting alone in her compartment, with her face to the engine), and suffered injury to her spine. The case was ultimately settled, a verdict, by consent of the Company, being entered for the plaintiff. Damages, £450.

COMPENSATION FOR RAILWAY INJURY, was also claimed [Common Pleas, Eamonson *v.* Birkenhead, Lancashire, and Cheshire Junction Railway Company, 6th July ult.] by plaintiff, an iron merchant in the City, and, up to time of accident, a commercial traveller for Mr. Mushet, of the Dalkeith Iron Works, in Scotland. On the 15th October last, he was a second class passenger from Birkenhead to Chester, by the 2·45 p.m. train When near Chichester, the train, driven at from 50 to 60 miles per hour, to make up for lost time, ran into an engine which was standing on the line. Plaintiff's carriage was knocked to pieces; and he himself sustained such injury to his nervous system as to incapacitate him from pursuing his avocations as commercial traveller; one painful symptom of the shock to the nervous system consequent on the accident, as given in evidence, being that "the scream of a railway whistle, or the noise of a train, produced a feeling, as though plaintiff had a tight wire jacket enclosing his body." As traveller in the iron trade, he had, previously, earned about £800 a year. Verdict for plaintiff. Damages, £850.

STEAM-TOWING ON CANALS.—In the Equity Court (before the Master of the Rolls), 13th July ult., Case *v.* Midland Railway Company, a question of considerable interest was decided. This was a bill filed by the owners of a steam-towing vessel, called the *Pioneer*, to restrain the company from preventing the steamer navigating the Ashby-de-la-Zouch Canal, which is vested in the Railway Company. The plaintiff's allegation was, that the steamer was fitted with an improved double-screw, which prevented any wear that could be injurious to the banks; but the company, without going into any inquiry as to this, closed the gates of the canal, and refused absolutely to admit the steamer. On a former occasion, when the case came before the Court, the Master of the Rolls had directed an experimental investigation, by competent engineers. The result of this was to prove that the steamer, when not going more than 3½ miles an hour, would do no injury to the banks at all; and that, even when going at a greater rate, it would only be injurious at places where the canal was shallow and serpentine. The Master of the Rolls now made a decree requiring the company to allow the plaintiffs to run their boat, at any-rate not exceeding 3 miles an hour; and said, that in case of their exceeding that rate, he would grant a perpetual injunction, on the application of the defendants. If the defendants had merely refused to admit the steamer until it was proved not to be injurious, the decree might have been different as to costs; but, under the circumstances, the company, having positively refused to let the steamer run at all, must pay the costs.

TYPE FOUNDING—VALIDITY OF PATENT [as to sufficiency of specification]. A case of some importance to patentees, &c. (the Patent Type-founding Company *v.* Richards), came (8th July ult.) upon demurrer before Vice-Chancellor Sir W. Page Wood, Equity Court. The plaintiffs were the assignees of a patent for a new combination of metals for type-founding, which had been granted to one Roberts. They had filed their bill against the defendants to restrain them from an alleged infringement of the patent. To this bill the defendant had demurred, on the ground of want of certainty in the specification. The Vice-Chancellor said, "the rule was that a specification should be of that certainty that a person having knowledge of the trade to which it referred could, by its means, make the patented article. In determining this case, upon demurrer, he must put it to himself whether, upon the evidence of competent workmen, this specification would be sufficiently clear. He could not say that that would not be the case, and the demurrer must therefore be overruled."—In other words, the specification was held to be sufficient.

THE DESTRUCTION BY FIRE OF THE "EASTERN MONARCH" TROOP-SHIP, at Spithead, on the 31st June ult. (See our last month's "Notes and Novelties.") At the Winchester Assize Court (Western Circuit), 18th July ult., the ship-steward, who stood committed for manslaughter for having (as alleged) caused the disaster by going down in the gun-room, striking a match, lighting an uncovered candle, and throwing a match on the floor, thus causing the explosion and subsequent catastrophe, was, on an intimation from the judge, and consequent withdrawal of the indictment for manslaughter, acquitted. Being then indicted for a misdemeanor, under the 239th section of the Act, 17 and 18 Vict—the Mercantile Marine Act—which enacts "that if any seaman shall by breach of duty or drunkenness do any act tending to the destruction or serious damage of the ship, or to the loss of life by any person on board, he shall be guilty of misdemeanor," the prisoner was, similar evidence as before being adduced by the prosecution, after a brief consultation, acquitted likewise of the imputed misdemeanor.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

WE have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "18, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

SHIPBUILDING STATISTICS.—Of timber vessels there were built and registered last year, in the United Kingdom, 863; and of iron, 137: the tonnage of the former was 144,051; and of the latter, 64,022 tons.

STEAM AND OTHER MACHINERY EXPORTED FROM ENGLAND, in the month of May, for the last three years, according to Trade and Navigation Returns:—

	1857.	1858.	1859.
Steam Machinery	£ 83,185	£208,304	£ 85,296
Other Machinery	304,191	258,584	212,989

AT MAURITIUS, the Royal Society of Arts and Sciences will hold an Industrial Exhibition, by permission of his Excellency the Governor, at Government House, Port Louis, on the 31st August, and the 1st and 2nd September next, when prizes will be awarded for the best specimens of produce and manufacture from the colonies of Reunion, Ceylon, Cape of Good Hope, and Mauritius.

THE PROPOSED EXHIBITION OF ARTS AND INDUSTRY OF 1861 has been officially declared to be "not abandoned, but merely postponed."

AN IRON PALACE FOR THE VICEROY OF EGYPT has recently been shipped at Havre, on board the *Ricardo el Negro*. It forms a magnificent summer palace, entirely of iron, and was built by the firm of Cannovière, of Havre. The structure weighs from 700 to 800 tons, and figured in the Paris Universal Exhibition, in 1855.

THE POLYTECHNIC INSTITUTION, of London, so useful in its day as a means of spreading a taste for mechanical knowledge amongst the people, has ceased to exist.

MOWING MACHINES—Four or five of these were recently tried at the Boreham Haymaking Festival, held at the seat of Sir John Tyrrel; a two-horse one, manufactured by Woods, did its half-acre in twenty minutes, which is equivalent to fifteen acres per day.

ANCHORS.—A copy of the report of the Anchor Committee, nominated by the Admiralty, to determine on the merits of different descriptions of anchors, was, 5th July ult., moved for, in the Commons, by Mr. Bentinck.

THE SHIPWRIGHTS' STRIKE ON THE TYNE AND WEAR still continues; the Sunderland shipwrights having recently met, and determined to carry on the strike. They will admit of no modification of their claim to 30s. per week.

THE SOUTH SHIELDS SHIPWRIGHTS have also held a meeting, and they refuse the offer made by the masters, viz., an advance from 24s. to 27s. a week. They refuse to take less than 5s. a day.

A PORTABLE SAW-MILL has been, for some time past, in the woods adjoining Ballinshoe. The mill is driven by a portable steam-engine, of about 8 H.P. It cuts up timber of considerable thickness with great ease and rapidity. Engines by Messrs. Clayton, Shuttleworth, and Co., of the Stamp End Ironworks, Lincoln: and the mill by Messrs. Young, Ballinshoe, Kirriemuir.

THE WESTMINSTER CLOCK question has again occupied Parliament. On the 11th July ult., the First Commissioners of Works, in answer to a question why only two faces of the "clock at the House" were now made use of?—said, the reason was that the minute-hand and the counterpoise were so heavy, that they would not work. Directions had been given to Mr. Dent to construct hands and counterpoises of proper weight.

TROTMAN'S, PORTER'S, AND OTHER ANCHORS FOR THE NAVY.—In the Commons, 11th July ult., on the vote of £2,117,431 for naval stores, building and repair of ships, and steam machinery, Mr. Lindsay said he had heard that the supply of anchors to the navy, was, and had been, since 1841, confined to one person: and that while the market-price, as charged by the most eminent makers, was £50 10s. a ton for 50 cwt. anchors, and £30 a ton for 5 ton anchors, the Admiralty were paying £73 and £44 10s. a ton respectively, Mr. Bentinck said, a committee had reported in 1852 in favour of six different kinds of anchors, all superior to those used by the Admiralty: why had no notice been taken of the report of that Committee? Why had it not been acted on? Sir Charles Napier said there had always been a perfect forest of anchors at each dockyard and naval stations, which must have cost a large sum. Who ordered, and who received them? He hoped there would be a full answer with regard to anchors. Sir John Pakington was informed that the opinion of experienced naval officers was opposed to the report of the Committee on Anchors. It was said that Trotman's anchor, when it held, was admirable; but you could not rely on its biting; and so the most valuable and critical quality of an anchor was wanting. Lord C. Paget remarked, it was a curious thing, that among professional men, if there was one thing which they differed about, it was an anchor; and, if they saw five or six line-of-battle ships together, they would be almost sure to all have different anchors. Mr. Corry observed that the principle of Trotman's and Porter's anchors was the same. That during the great storm at Balaklava 22 merchant ships went on shore, but not one of the navy. Here the discussion dropped, and the vote was agreed to.

FOR CURRYING LEATHER, A NEW PROCESS has been invented, and patented by Mr. Gregg, an extensive currier, of Sheffield. On the 13th July ult., about 150 gentlemen connected with the leather-trade assembled at one of the large establishments at Bermondsey, to witness a practical exposition of the new method, the principal feature of which is, that by its adoption, the old course of fourteen processes will be reduced to seven, and the time required for completion, from a fortnight to about two days. In the new method, the "dry stuffing" or saturating with "dubbing," or other oleaginous matter, is performed while the skin is dry, instead of after soaking in water. Some beautiful specimens were exhibited, the whole of which had been completed in three days. Practical illustrations of every stage of the new process were given by the inventor, to the entire satisfaction of the meeting.

THE "MYRIA TYPE" MACHINE of M. Combarieu, an important improvement in type-founding, has been submitted to the Government, and accepted for inspection. If all that is said of it is true, this invention is destined to produce a revolution in the type-founding trade. It produces 10,000 characters at one stroke. Each letter is then separated by a mechanical saw, which divides them with mathematical regularity and precision. On the old system, the characters are moulded one by one, and the best workman can scarcely produce 5,000 of them in a day, in the rough, and they have afterwards to be passed through several hands. M. Combarieu announces, moreover, his intention of producing characters in steel, the durability of which will be beyond calculation

NEW LIFE-BOATS.—The National Life Boat Institution tried some experiments (25th June ult.) with a new life-boat, on the Limehouse Canal. Designed by Mr. Peake; built by Messrs. Forrestt, of Limehouse. Having been capsized by a crane, her self-righting power found to be effective. The water shipped was self-ejected through six relieving-valves in twenty-five seconds. With her crew of thirteen men, and gear on board, her line of flotation was found to be below the deck. Twenty-three men had to rest on the gunwale, or side of the boat, before it touched the water—an evidence of the boat's stability and power against capsizing. She has since been forwarded to Ayr. The English Railway Companies have always generously carried the life-boats of the Institution, free of charge; but the Glasgow and South Western Railway demanded payment for the conveyance of the life-boat, which is to be stationed in their own locality.

LOCOMOTIVE TOLLS.—A Bill has been introduced into the Commons, enacting a rate of tolls to be levied, by Corporations, Commissioners of Roads, Trustees, &c., on locomotives used on turnpike-roads—viz.: For every locomotive attached to any loaded waggon or carriage, 1s.; for every waggon, van, or carriage, drawn by such locomotive, and having the felloes of the wheels not less than 6, nor more than 8 in. in breadth, 3d. for each pair of wheels; for every waggon, van, or carriage, drawn by such locomotive, and having the felloes of the wheels not less than 8 in. in breadth, 4d. for each pair of wheels. Every locomotive must consume its own smoke. In the preamble to the Bill, it is recited that the use of locomotives is likely to become common on turnpike-roads for drawing waggons and carriages, and that the existing Turnpike Acts do not provide for the contingency. Read a second time, in the Commons, 6th July ult., and referred to the Select Committee.

"BRILLIANT CUT" ORNAMENTAL GLASS.—The *Great Eastern* steam-ship is to be fitted with up with this material, by Messrs. Mark Bowden and Co., of Bristol.

INSPECTION OF FACTORIES.—A deputation from the factory operatives of the manufacturing district of Lancashire had, 12th July ult., an interview with Sir G. C. Lewis, at the Home Office, on the subject of more efficient inspection of factories The object of the deputation was stated to be, not to seek for new legislation, but for more efficient protection, in order to put down violations of the law, now going on to an increased extent. Mr. Cobbett, M.P., one of the deputation, thought that new legislation was necessary, and would not bind himself down as to his future course. The Home Secretary replied that he did not think any case had been made out for new legislation; but as it had been stated that the number of factories had been increased 50 per cent. since the first appointment of inspectors, one of two things was clear—either there was a lavish appointment at the time, or a reconsideration of the number and means of inspection was necessary.

The Shad Thames Flour Mills, Bermondsey, a very extensive block of warehouses, six storys high, on the Surrey side of the river, and belonging to Messrs. Parkes, were, at 9 p.m. 13th July ult., completely destroyed by fire; the loss includes the costly machinery and many thousand quarters of wheat, flour, &c. Cause assigned—the breaking of a wire of a machine in the "dressing" room, on the fourth floor; and the same requiring to be instantly repaired, a man took a light into the place to see to put on another wire; but the moment he entered, the husk from the wheat came in contact with the light, and hence the catastrophe.

The New Brick-making Machine, for making bricks from dry clay (Bradley and Craven's Patent), was amongst the mechanical novelties exhibited, in action, at the late Warwick Agricultural Show. Clay, taken from the hill-side, was ground to powder, and transformed into the densest bricks possible, fit at once for the kiln, in the space of one minute and thirty seconds. On the old system, clay must be cast in winter, tempered in heap, and wrought in the "pug" before it can be moulded. Hence the utility of the new machine, which, with six moulds, and driven by a 6-horse engine, at four strokes, to deliver twenty-four bricks per minute, is capable of giving 330 tons pressure on the six bricks. House bricks were exhibited, made from dry silica, by this machine. Ordinary clays require a pressure varying from 20 to 30 tons for each brick. The moulding part of the machine weighs 25 tons.

The Salary of the Engineer to the Metropolitan Board of Works is, henceforth, on the recommendation of the Main Drainage Committee, to be increased by the annual allowance of £200 for travelling expenses, in consequence of the increased duties and expenses of the engineer, by reason of the main drainage work. Recommendation of the Committee carried by majority (of the Board) of 22 to 2, 15th July ult.

The Extensive Wool and Yarn Store, at Devonside, Tillicoultry, Scotland, in connection with the mill belonging to Mr. Vicars, was, morning of 12th July ult., totally destroyed by fire. Loss estimated at £20,000. Property not insured. Origin uncertain.

The "Exposition Regionale" of Rouen, a species of district show for the encouragement of industrial merit, was opened on the 1st July ult. The number of exhibitors (of objects of manufacture, machinery, metallurgy, glass-ware, chemical products as applied to manufactures, &c., &c.), was upwards of 1,400. The more remarkable of these we have noticed in our present number under their respective heads. Suffice it to say, that the Rouen "Régional" Exhibition, both as respects its object, its general arrangement, and the industrial importance of the specimens of artizanship exhibited, reflects the greatest credit on all concerned in its formation and working details.

Wrecks, &c., in 1858.—The number of vessels wrecked on the coasts, and in the seas, of the United Kingdom, in 1858, was 1,170; of these 354 were total wrecks, and 50 sunk by collision, making the number totally lost 404. Vessels stranded and damaged, so as to require to discharge cargo, 515; by collision, 251; total, 776; making the whole number of wrecks 1,170. By these disasters the lives of 1,895 persons were imperilled, of which number 340 persons, or ·18 were actually lost.

Icebergs and Shipping. — The "Indian Queen," Black Ball Clipper Ship, from Melbourne, for Liverpool, which recently had to put into Valparaiso, having struck an iceberg, being deserted by captain, chief-mate, and thirteen of the crew, who were drowned, has been condemned, the estimated necessary repairs, so as to allow of her proceeding to Liverpool, being estimated at £7,000.

The Pneumatic Dispatch Company Bill, 21st July ult., passed the Commons.

The Price's Patent Candle Company Bill received, 21st July ult., the Royal Assent.

Oiling a Vane.—Daring Feat.—At Salisbury, 19th July ult., a workman performed the intrepid feat of ascending to the summit of the Cathedral spire, for the purpose of oiling the vane, which is at an altitude of 404 ft. from the ground. This was accomplished by means of small iron handles, which are firmly fixed to the exterior of the spire. Before descending, he mounted the cross above the vane, and, at that dizzy height, stood upright upon it.

Life-Boats.—By the National Institution life-boats, and other crafts, 1,555 persons were during the past year, rescued from shipwreck. The Institution has now eighty-two life-boat establishments under its management.

RAILWAYS, &c.

The Railway Companies' Arbitration Bill was (5th July ult.) introduced by leave (on motion of Col. W. Patten) into the Commons. Its object is to enable railway companies to settle their differences with other companies by arbitration.

Enormous Railway Traffic.—More than 13 millions of persons use the railway station at London bridge.

The Charing Cross and South-Eastern Railway Bill has, 19th July ult., passed the Committee of the House of Lords (consisting of Lord Belper, chairman, Earl Spencer, Earl of Munster, Viscount de Vesci, and Lord Talbot de Malahide, having already passed the ordeal of inquiry in the Commons. The opposition of the Metropolitan Board of Works had been withdrawn, and this board were petitioners before the Lord's Committee, praying that the bill might pass in its present form, inasmuch as they found that their long-projected new street in Southwark, will, in point of fact be greatly benefited, and not, as they had first contended in the Commons' Committee prejudiced by this great undertaking. The only opponents of any importance were the Governors of St. Thomas's Hospital, to meet whose powerful opposition the promoters, in addition to the offer of compensation to the amount of £20,000, &c., proposed to construct the line of railway on iron columns of 24 ft. in height, which would rest on the garden of the hospital, so as to afford as little obstruction to light and air as possible, and the removal of some houses in Wellington Street to provide for the passing of the railway, and giving an increased amount of open space in front of the hospital. Further that the sides of the railway should be constructed of lattice work, in order not to interfere with the ventilation of the hospital; that the roadway should be formed of india-rubber, or some other material which should deaden the sound of passing trains; that no train be allowed to pass the north wing of the hospital at a speed of more than six miles an hour; that the steam whistle should not be sounded except in case of absolute danger; and that the arcades leading to the railway station should be removed so as to give increased ventilation. These offers were rejected by the Hospital. The Lords' Committee, however, declared the preamble of the Bill to be proved, adding that they must leave the question to be settled by the parties as the law provided.

Spanish Lines.—Saragossa to Madrid.—The returns for the first few days of the traffic on the section [from Madrid to Guadalajora] of this line, have been highly promising; the receipts having varied from 7,000 to 14,000 reals per diem. A considerable increase on these receipts is anticipated from the great number of visitors who, in the summer season, will frequent the baths of Sacedon and Teille.

Alcazar and Manzanares.—The "Gaceta de los Caminos de Hierro" announces that the Government have paid to this company 10 millions of reals, on account of the subvention accorded for the Madrid to Saragossa railroad. This sum is to be applied to the works of that portion comprised between Alcazar and Manzanares, the first section of the Alcazar and Ciudad Real line.

Seville to Cordova.—The inauguration of this line, which took place, by order of the Minister of Public Works, on the 2nd June last, had been postponed from the 25th of the month preceding, in consequence of certain difficulties raised by the local administration. The present (provisional) service on the line consists of two mixed-trains daily, and a goods'-train.

The Madrid to Saragossa and Alicante Line appears scarcely, hitherto, to have fully answered the hopes of its promoters. It must be borne in mind, however, that the year 1858, has, from failure in crops, especially, offered a period of exceptionably unfavourable operation on mercantile affairs in Spain; and, consequently, on the Saragossa and Alicante portion of the line, there was a sad falling off in the, not unreasonably, anticipated amount of goods traffic in grain, fruit, &c. However, the report for 1858, shows a total (gross) receipts of 10,012,458 francs, with a nett profit of 3,131,989 francs; sufficiency for a dividend (small indeed, as compared with what was anticipated), on shares. The company has acquired the Alimanza and Valence line for 151,605 fr. 26c. per kilomètre: that of Castellejo to Toledo for 140,000 fr. per kilomètre; as likewise the concession of the Alcazar to Cuidad Real line, with a subvention of 44,450 fr. per kilomètre. The Madrid and Saragossa line is also to be transferred to them by the "Mercantile Company" on highly advantageous terms.

The Projected Line of Railway from Huesca, through the Pyrenees, *viâ* Gabarine, to join the French lines, has been disapproved of by the Junta appointed to report upon it, on the ground that such line would compromise the safety of the country by facilitating invasion. This decision is notified in the Madrid journal of the 7th July ult.

Albacete to Carthagena.—The Spanish Government have advertised [in the "Madrid Gazette,"] for tenders for the concession of this line—a first-class one.

A Jamaica South Coast Railway is proposed, with a capital of £60,000 in £5 shares, to consist of 11 miles, to a point called Old Harbour, and forming a continuation of the existing Jamaica railway, which connects the Port of Kingston with Spanish Town. The Jamaica legislature have authorised a guarantee of a minimum dividend of 6 per cent. for 40 years on the estimate cost.

The Metropolitan Railway [Deviations, &c.] Bill, was, 15th July ult., read a third time, and passed in the Commons.

Railway Rating.—The South-Eastern Company have succeeded, in their long-pending contest with the parish of Battle, as to the rating of their railway. The result of the appeal heard at the Lewes Quarter Sessions, 29th June ult., was the reduction of the Battle rate from £700 to £420 upon the railway, and from £150 to £80 upon the Battle Station. The same Company's appeals against several poor rates in the parish of Rye, referred to arbitration, have likewise ended in a reduction of the assessments from £75 to £40 in that parish.

On the Lombardo-Venetian Railway, notwithstanding the unsettled state of affairs, the traffic continues to be carried on with, under the circumstances, surprising regularity. The receipts for the week ending the 17th June ult., show an increase of £20,294, or more than 60 per cent., although, owing to the military movements, the earnings on the Lombard portions are not all included.

Cape Town.—Both the railways, according to late advices, have fallen into difficulties.

Novara to Milan.—The "Eco della Borsa," of Milan, says that the Emperor Napoleon has insisted upon the immediate restoration of this railway line.

Russian Lines.—The works in progress on the various lines conceded to the "Grand Society of Russian Railways" are being pushed forward with such activity that there are now in actual employment on them as many as 49,000 workmen.

Central [of Belgium].—The "Moniteur Belge" publishes the law authorising the concession of a central railway to Marchienne-au-Pont—being a concession made to the anonymous society known as the Central Railway Company [Chemin de Fer du Centre], subject to the clauses and conditions of the convention, dated 9th April, 1859.

The Dutch-Rhenish Railway Company have (meeting held at Amsterdam, 30th July ult.) come to a good understanding with the Cologne and Minden Railway Company; and the coal traffic has now commenced, at a freight not exceeding that charged by the boat conveyance.

The New Brunswick and Canada Railway Company have invited tenders for the completion of the line from Howard Settlement to Richmond Corner, a distance of 25 miles.

The Bombay, Baroda, and Central India Railways' Works are progressing satisfactorily. A train has been run over 33 miles of the line (from Ahmedabad to the Veturnie River), and it is expected that at the end of 1860, 260 miles will be open for traffic. The undertaking has sustained a severe loss through the wreck of a fine vessel called the *Pedestrian*, which had on board 300 tons of rails, and a similar quantity of material for bridges; this has been the cause of a serious delay.

Alarum.—Communication between Railway Passengers and Driver.—A new invention for this purpose has recently been patented by Mr. Batty, of Manchester: it consists in placing, in the weather-board on each side of the engine and driver, a mirror or looking-glass, in which the whole of each side of the train is reflected, and which is accessible to either driver or stoker. Many engines have at present a weather-board, in which is inserted a piece of plain glass, through which the driver and stoker can look ahead, with protection from the weather, and in such case the mirror would be placed outside this plain glass, flush with the foot-boards of the carriage. For night application, the inventor attaches a lamp on each side of the last carriage of a train, and the reflection of this lamp in the mirror readily exhibits any irregularity in the train that may occur after darkness has set in; whilst the hand or handkerchief of the guard, or of a passenger, put out of window, between the light and the mirror, is reflected in the latter as clearly as by day. In the case of a train catching fire, the smoke or flame reflected in the mirror will be a sufficient signal for the driver or stoker to stop the train. Coloured lamps, and flags, in the hands of the guard, serving as a means of communication with the driver—the former by night and the latter by day—are also proposed.

A "Steam Ice Carriage, moving on runners," in place of wheels, upon the frozen surface of rivers and lakes, instead of the iron-way, and thus available for using the natural ice-roads, has been invented in America: and at Prairie du Chien, in Wisconsin, a company have purchased the right to use this new mode of communication (in winter) by steam, upon the Upper Mississippi, preparations having been made to open a great north-western route by the way of the Mississippi, St. Peter's, Red River of the North, Lake Winnexey, and the Saskatchewan River, from Prairie du Chien, through a pass of the Rocky Mountains, to the head-waters of the Fraser and Columbia Rivers, the fountains of which rivers, emptying into the Pacific Ocean, are but 317 yards from the fountain of the Saskatchewan and its affluents. This forms a continuous and available ice-road, 3,000 miles in length. The ice-carriages consist of iron boats of sufficient capacity to sustain the whole apparatus in the water in safety. They are provided with a cable, similar to that of a canal packet, and with similar conveniences and comforts. They are propelled by steam, applied to a single driving-wheel, penetrating the ice with an elastic graduated pressure; and they are steered by a wheel, passed forward in a pilot-house, and by means of which the pilot has control over it. The whole structure rests upon two pairs of "runners," so adjusted by screws, that the whole may be raised or lowered to pass snow and other obstructions, whether in motion or at rest. The calculated rate of speed is about equal to that of a railroad mail-train. Inventor, Mr. Nounan Wiard. The invention, says the "New York Times," promises to open up a vast field of winter navigation, not only on the American Continent, but also in the frozen regions of Europe and Asia.

Snow on Rails.—The Illinois Central Railroad was blocked up by snow for six weeks during the winter of 1856-7; and the machinery was broken by the frost, causing serious damage and delay. On the Northern Railroad, from Toronto to Georgian Bay, in Upper Canada, it has been found necessary to suspend railway operations during the winter; and the Government, last year, prohibited the running of trains on its tracks. Much of the damage arises from the severe concussion which, with the unequal contraction and expansion, breaks the wheels and injures the rails.

The Battersea to Norwood portion of the West-End of London and Crystal Palace Railway has been purchased by the London, Brighton and South Coast Company; the arrangement takes effect from the 1st July, 1859. A sufficient amount of stock created expressly, is to be delivered to the West-End, &c., shareholders, in exchange for their shares in the Battersea to Norwood undertaking.

The Victoria (Pimlico) Station.—The Directors of the London, Brighton and

South Coast Company are making arrangements to become possessed of the whole of the Victoria Station and Pimlico Railway property so that a general terminus may be erected, free from the inconvenience and complication attending the working of separate and independent stations; for this purpose they have entered into an arrangement with the Directors of the Victoria Station and Pimlico Railway, the result of which will be, that the whole of the latter undertaking will ultimately be vested in the South-Eastern. The North-Western and Great-Western Companies, will, by agreement with the South-Eastern, have the use of the requisite portion of the West-End Line, and of the Victoria Station and Pimlico Railway.

THE NORWOOD TO STREATHAM SECTION [South-Eastern Line] lately rejected by the Commons Committee, is to be revived; efforts being now made to obtain a recommittal of the Bill, with a view to its passing during the present session.

AN EXTENSION OF THE BRIGHTON RAILWAY [by a branch line from Pulborough to Arundel] is to be constructed without delay; forming a (hitherto much wanted) connecting link between the eastern portion of the country and the main line. A branch to Bognor is likewise in contemplation.

THE WEST-END OF LONDON AND CRYSTAL PALACE RAILWAY BILL (No. 1), was, 20th July ult., ordered for third reading in the Commons.

FROM TREBIZOND TO ERZEROUM the railway is completed. The Russians are surveying a line which is to connect the BLACK SEA with the Caspian, and will pass through Poti, Tiflis, and Bakou. The construction of these roads will establish a rapid communication between the provinces of the Caucasus on the one hand, and ASIA MINOR and PERSIA on the other.

RAILWAY ACCIDENTS:—

TO A GOODS TRAIN.—On the London and South-Western Railway (25th June ult.), as a luggage-train was nearing the Kingston-on-Thames Station, the guard alighted from his van when the train stopped, to attend to his parcels. The driver, however, found that the train had not quite reached the front of the station, and set the train in action again. Just at that second, the man's foot slipped and he fell; the wheels of the engine and truck passed over him, and he was terribly mangled. He was forthwith conveyed to St. Thomas's Hospital.

TRAIN ON FIRE.—On the Manchester and Chester Railway (18th June ult.), the 12·55 afternoon train, from Manchester to Chester, had just passed the Kenyon junction, when the lugguge on one of the carriages was discovered by a passenger to be on fire. The guard and driver in front could not for some time hear the alarm given, but ultimately the train was stopped before the roof of the carriage gave way. Had it been an express-train the result would, no doubt, have been disastrous. As it was, the luggage was destroyed, some tin boxes being completely melted. The passengers alighted in great alarm, and the incident has been commented upon as a further proof of the absolute necessity of some means of communicating alarm from passengers to guard or driver.

THE READING RAILWAY STATION, belonging to the South-Eastern Company, was at an early hour on Sunday morning, 26th June ult., wholly destroyed by fire. It was an entirely wooden structure, with an adjoining covered platform, about 100 ft. in length. The fire is thought to have originated in the "lamp-room," erected at the extreme end of this platform. In a very short space of time, a brisk wind prevailing, the entire station was one mass of ruins, the roof having fallen in, followed by a stack of chimneys. Fifteen horses in a stable about 20 ft. below the level of the railway, were with great difficulty rescued, the thatch having been ignited by pieces of burning wood flying about in all directions. The telegraphic communication was stopped by the destruction of the instruments and the severing of the wires. Total loss of property very considerable; as, in addition to station being burnt down, a large quantity of luggage belonging to passengers, &c., was destroyed.

A TRAIN of six cars, on the Michigan Southern Railroad, near South Bend, Indiana, was, about midnight, 27th June ult., thrown down from the track by the washing away of a culvert. About 150 passengers were in the train. The stream where the accident occurred is, naturally, a small rivulet, but was much swollen by heavy rains, the previous afternoon and evening, which seems to have had the effect of sapping the abutments of the culvert. Sixty persons were taken from the ruins dead, and fifty others wounded.

DEFECTIVE BREAKS.—A fatal railway accident occurred 11th July ult., at the Longridge station of the Fleetwood, Preston, and West Riding Junction Railway, about 7 miles from Preston—a single line. Three waggons, laden with stone, left the higher stone delf, about a mile beyond the Longridge station, for Preston, Between Longridge and Grimsargh, the line forms a very deep declivity, down which the stone-waggons usually descend by their own momentum, the breaks being applied for the greater part of the distance by a man regularly engaged for that purpose. On the occasion in question, one of the breaks of the waggons would not work, and the breaksman was in the act of stepping across the waggons, to apply another break, when he missed his footing, and, falling between the waggons, he was literally cut to pieces. The waggons, with increasing velocity, ran down the declivity, towards Grimsargh, at a speed of 60 miles an hour. The station-master ran to a pair of points, and succeeded in turning the waggons on to a siding, against which they came into violent collision, the first waggon being smashed to pieces, and the contents of the others scattered over the line, But for the presence of mind of the station-master, a fearful collision, between the waggons and a passenger train from Preston, arriving at the moment at the Grimsargh station, must necessarily have taken place.

A LABOURER ON THE LONDON AND NORTH-WESTERN RAILWAY was in the act of crossing the rails (having been employed getting the hay from the embankment of the line, near the Marsh Brook, Hampton-in-Arden), when an express train came upon him, struck him down, and killed him on the spot. Coroner's verdict—"Accidental Death."

A CHILD ON THE NORTH-EASTERN RAILWAY, walking near the rails, at the Scarborough Station, 11th July ult., and having strayed from its companions on to the lines, was knocked down by a luggage train, the whole of the carriages passing over its body. Death instantaneous.

OF RAILWAY ACCIDENTS, during the year 1858, the recent official report gives 276 killed and 556 maimed, on all the railways of Great Britain and Ireland. The report is heavier than in any year since 1853. Railway servants or labourers, killed, 131; and 101 injured. Of trespassers on the rail, only 11 out of 73 escaped; the remainder being killed outright. Of passengers, 400 were injured, and 26 killed. This out of a gross total of 140,000,000 passengers conveyed.

A SERIOUS COLLISION occurred recently at Dudley Station of the Oxford, Worcester, and Woverhampton Railway, resulting in injury to several persons, but fortunately in no fatal accident. As the Dudley for Wolverhampton train was preparing to start at 12 o'clock, a goods-train was being shunted back towards Dudley. The driver of the passenger-train started his engine before the goods-train had cleared the crossing, and the two trains met with great violence. The passengers were thrown from their seats, some of them being much bruised. One of the buffers of passenger-engine completely smashed, and two or three of the goods-trucks damaged, the buffers and breakers being smashed to pieces.

PLACING STONES ON THE RAIL.—At the Lambeth Police Court, 21st July ult., two lads were charged with wilfully placing stones on the metals of the Brighton and South Coast Railway. The magistrate remarked that the offence was one of a very serious character indeed, and remanded the prisoners for the attendance of their parents.

TELEGRAPH ENGINEERING, &c.

THE RED SEA AND INDIA TELEGRAPH Company Bill was, 2nd July ult., read a third time in the Lords, and passed. It has since received the Royal Assent, so that the unconditional guarantee granted to that undertaking, and which has lately been the subject of much discussion, is now established beyond question.

THE NEW ELECTRIC CABLE BETWEEN ENGLAND AND FRANCE [Boulogne and Folkestone] has been successfully submerged (on the 26th July ult.) by the Submarine Telegraph Company. This is the largest and stoutest yet constructed, and contains six conducting wires, of gauge No. 1, surrounding a hempen core. These wires are covered with hemp, and the whole is enclosed in twelve iron wires of gauge No. 0. Weight per mile nearly 10 tons. After the immersion, perfect signals were interchanged upon all the six corresponding wires. Manufactured by Glass, Elliott, and Co., the contractors.

SIGNALS AT SEA.—A new and ingenious mode of signals, by lights, has been recently exhibited at the Underwriters' Rooms, Liverpool, and appears to have given general satisfaction. This new patent is the invention of Mr. Ward, an American, and consists of four lamps attached to an iron frame in the shape of a cross. These lamps can all, and at one time, be changed from a white to a red light, and as often completely obliterated, so as to suit the time and occasion of signal.

FROM POINT LYNAS TO GREAT ORMSTEAD the telegraph-line, for the use of the Merchant Service of Liverpool, was (5th July ult.) successfully laid by Messrs. Glass, Elliott, and Co., for the Trustees of the Mersey Docks. The old semaphore system, which has been in use up to the present time, will be immediately superseded by electric communication between Liverpool and Holyhead.

THE BRITISH AND CANADIAN TELEGRAPH COMPANY BILL was (19th July ult.) ordered for third reading in the Commons.

THE TELEGRAPH WIRE TO COSSEIR, recently laid, has been injured by an anchor falling on it, but will speedily be repaired.—[Late advices from Malta.]

THE ISLE OF WIGHT TELEGRAPH BILL passed the House of Commons 6th July ult.

THE RED SEA TELEGRAPH BILL [No. 2] came (11th July ult.) before the House of Commons, for consideration of the Lords' amendments thereto. After some opposition, more especially as respected the clause enabling the *ex-officio* directors nominated by the Crown to become shareholders, the House divided (on Sir J. Graham's amendment to postpone)—177 for, 130 against; majority, 47; and the Lords' amendments were agreed to.

THE SUBMARINE TELEGRAPH COMPANY'S EXCLUSIVE RIGHT to lay down lines of telegraph between England and France, and their other arrangements with the English and French governments, were (11th July ult.) the subject of inquiry in the Commons: the Government had no objection to lay the correspondence on the subject on the table.

THE NEW LIVERPOOL DOCK-TELEGRAPH (just completed along the whole line of docks) is, by decision of the Mersey Harbour and Dock Board (17th July ult.), to be leased to a public Company, instead of being kept, as first expected, in the hands of the Board. The cost of repairing and maintaining it in working order is estimated at £50 per annum; total receipts for the transmission of messages, at £1,565; working expenses, at £1,124; leaving a profit of £441.

DENMARK.—THE CABLE FROM WEYBOURNE, ON THE NORFOLK COAST TO TONNING, on the shores of Denmark, has been successfully submerged for a portion of the line by the Submarine Telegraph Company. The cable comprises three wires, is 338 miles in length, and was supplied by Messrs. Glass, Elliott, and Co.

SHELL-LAC, AS AN INSULATOR FOR SUBMARINE CABLES, has been adopted (or at all events patented) by Mr. Horstmann, of New York. He proposes to use a thick coating of the gum as an insulator; as also to manufacture his cables on board the vessels, as it is being paid out into the ocean.

LIGHTNING INJURIOUS TO TELEGRAPH WIRE.—Recently, at the Jersey Submarine Telegraph Office, during a violent thunder storm, an explosive noise like that of a pistol was heard, and the transmission of messages was suddenly checked. It was ultimately, after a fruitless search, elsewhere, for the cause of interruption, found, that both coils of wire, in the office itself, had been so burnt by the electric force as to render them quite useless. The coils being replaced, and connected, communication was immediately restored.

SICILY is about to be united to MALTA by an electric cable.

BETWEEN ALEXANDRIA AND THE ISLAND OF CANDIA, to complete the connection from ADEN TO LONDON, *viâ* Constantinople, the line has temporarily failed. The expedition started from Alexandria on 25th May last, and the line parted on the 1st June, when the whole had been laid, within 60 miles.

INDEPENDENT [ENGLISH] SUBMARINE TELEGRAPHS.—In the Lords, 19th July ult., Lord Stanley of Alderley presented a petition from bankers, merchants, and others of the City of London, in favour of the establishment of direct and independent lines of submarine telegraphs between Great Britain and Her Majesty's possessions abroad, not subject to interruption by reason of the outbreak of war in any of the Continental Governments through which, at present, the lines of telegraphic communication pass. It was officially intimated that the subject should receive the due consideration of Her Majesty's Government.

THE CABLE LINE TO GIBRALTAR.—On the same occasion, the Government intimated that it was, no doubt, desirable to proceed with this line as speedily as possible; but that the necessary surveys would occupy some time, and there were *other reasons* for not proceeding too hastily.

MALTA AND ALEXANDRIA.—To a question, whether the Government had determined to lay down this line, Lord Wodehouse replied, that the subject was under consideration, but no decisive conclusion had been arrived at.

THE RED SEA AND INDIA TELEGRAPH BILL received the Royal Assent 21st July ult.

THE ATLANTIC TELEGRAPH BILL (No 2) received the Royal Assent 21st July ult.

MARINE STEAM ENGINEERING, SHIPBUILDING, &c.

STEAMER STATISTICS.—The number of steamers of 50 tons, registered in England at the end of last year, was 626; and above 50 tons, 821. In Scotland, 70 and 244 respectively; in Ireland, 30 and 125. British steamers engaged in the foreign trade, 5,000.

THE "TOPAZE," 51, SCREW STEAM-FRIGATE has been brought from Hamoaze to the Devonport Dockyard for convenience in fitting out.

THE TWO RUSSIAN GUN-BOATS, *Soukssou* and *Killissoury*, noticed in our last, put into Plymouth, recently, for fuel, and sailed thence for Odessa.

THE "VICTORIA AND ALBERT" steam-yacht, was, 1st July ult., brought down alongside the dockyard, at Portsmouth, to make good repairs in her machinery.

A GUN-BOAT, BUILT FOR THE TURKISH GOVERNMENT, was launched, 2nd July ult., at Northam, Southampton. One of the gun-boats ordered by the late Government will be laid down on the same stocks.

THE QUESTION OF THE ATLANTIC STEAM NAVIGATION COMPANY'S [GALWAY] contract with the (late) Government, to carry the mails between Galway and the United States, and the propriety of its being cancelled, was raised, 5th July ult., in the Commons. The Chancellor of the Exchequer, in reply, promised to move for an inquiry into this and the other mail-service contracts for some years past, entered into with different Governments.

THE "GREYHOUND," 17, NEW SCREW STEAM-SHIP, was, 4th July ult., towed from Plymouth Sound into Hamoaze. She will be dismantled, receive her machinery, and be placed in the steam reserve.

THE "GALATEA" SCREW STEAM-FRIGATE, recently built at Woolwich, is to be launched this month (August). On the 11th July ult. preparations had already commenced for the launch.

Screw-Steamers Added to the Navy, between 1st March, 1858, and 1st June, 1859, according to the original scheme of work, for the year 1858-9:—The *Donegal*, 101; *Windsor Castle*, 100; *Revenge*, 91; *Edgar*, 91; *Hood*, 91; *Hero*, 91; *London*, 90; and the *Lion*, 80. Also the following frigates:—*Topaze*, 51; *Forte*, 51; *Orlando*, 50; *Mersey*, 40. Together with the corvette *Clio*, 22; and the sloop *Icarius*, 11. The following ships were converted into ships of the line in consequence of subsequent orders:—The *St. George*, 90; *Neptune*, 90; *Trafalgar*, 90; and *Queen*, 86.

The Machinery and Boilers for the *Victoria*, 121, screw, arrived, 8th July ult., at Portsmouth, by the *Rhadamanthus*, 4, steam store-ship.

The "Urgent," Iron Screw Steam Store Ship, was taken out of dock (Portsmouth), 8th July ult., into the steam-basin.

The "Irresistible," 80, a fine Screw-Steamer (line-of-battle), now being built at Chatham, is so far advanced, that she is likely to be afloat in the course of a few months.

A First-class Screw Steam-frigate, to be named the "Undaunted," is ordered to be immediately commenced at Chatham. She is to be pierced for 51 guns of the heaviest metal; she will be one of the largest of her class afloat, and is expected to be completed and launched within a twelvemonth of the present time.

On the Screw-Steamer "Rattlesnake," 20 (one of the new vessels of war recently ordered to be built at Chatham), the shipwrights are busily employed.

The "Atlas," 91, and the "Bulwark," 91, are both on the stocks, at Chatham, progressing.

The "Rodney," 90, and "Severn," 51, in dock, are being converted into screw-steamers.

The Collins Line.—From New York we learn that the three steamers, *Adriatic*, *Atlantic*, and *Baltic*, comprising the Collins' Line, formerly running between New York and Liverpool, were, 9th July ult., sold to the Pacific Mail Steamship Company, to be employed in the California mail services. Price not stated.

The Iron Steam-Frigate [Steam Ram].—In the Commons, 21st July ult., in answer to a question on the subject of this vessel, contracted for by the Admiralty with the Thames Iron Company, the Admiralty Secretary, Lord C. Paget, said, the vessel was to be launched in eleven months from the date of the contract, and to be masted three days afterwards.

The Steam Navy.—Of the 120 vessels, exclusive of mortar-vessels and floats, now lying in ordinary in the Royal Navy, seventeen are to be converted into screw-ships, and the conversion of seven others is under consideration. Four ships have been broken up or sold, since January, 1830, without having been commissioned.

The North of Europe Steam Navigation Company's affairs were the subject of much animadversion at the late meeting of shareholders, called in conformity with the 104th clause of the Joint-Stock Companies' Winding-up Act. The total cost of the ships of the Company was £344,000, of which they have now realised, £112,000; leaving a loss of £232,000. The loss by the trading has been £160,000. Of the vessels purchased from the Northern Steam Packet Company, the *Jupiter*, which cost £5,000, has been sold for £1,250, to be broken up; and the *Cumberland*, *Royal Victoria*, and two others, have realized £13,000; the *Cumberland* alone having cost £17,000.

The "Octavius" (50), Sailing Frigate, is to be converted to a screw frigate.

The "Wasp," Small Screw Steamer, destined for the attempted discovery of the source of the Nile, and which went out to Egypt on the upper deck of the *Pera*, has been safely launched in Alexandria harbour, and the explorers (Messrs. Forth and Wenham) departed (22nd June ult.) in her for the River Nile, on their expedition to endeavour to discover its source.

The New Iron Steam Ram, the contract for which, as we have formerly noticed, has been taken by the Thames Iron Ship-building Company, is to be a wrought-iron vessel of immense size, strength, and steam-power, especially adapted as a vessel of war, and for running down ships of the largest kind. Sufficient progress has already been made with the iron work to be used in her, to make it certain that she will be afloat, and fitted for sea, by June next. Her dimensions will be—Extreme length, 380 ft.; breadth, 58 ft.; depth, 41 ft. 6 in.; tonnage, 6,177 tons. Engines by Penn and Sons, of 1,200 H.P.; their weight, with boilers, 950 tons: she will carry 950 tons of coal; and her armament, masts, stores, &c., will amount to 1,000 tons more. At sea, her weight will be about 9,000 tons: which will be driven, when so wanted, through the water against an enemy's ship, at the rate of 16 miles an hour. The keel, or rather the portion to which the ribs are bolted, is made of immense slabs of wrought scrap-iron, an inch and a quarter thick, and 3 ft. 6 in. deep: from this spring the ribs, massive wrought-iron T-shaped beams, which are made in joints about 5 ft. long by 2 deep, up to where the armour plates begin, 5 ft. below the water-line. These beams are only 3 ft. 8 in. apart; while, for a distance of 10 ft. on each side of the keel, they are bolted in at only half this distance asunder. Five ft. below the water-line, the "armour-plates" commence, and, to give room for these, the depth of rib diminishes to about half, or 9 in. Over the ribs, and crossing transversely, are bolted beams of teak, a foot and a half thick; and, outside these again, come the armour-plates. Each of these is to be 15 ft. long by 4 ft. broad, and $4\frac{1}{2}$ in. thick. Whether these latter shall be made of puddled-iron, of annealed scrap-iron, or of scrap-iron unannealed, so as best to withstand the attack of 68-pounders, will depend on the result of practical experiments now being made at Portsmouth. These ponderous slabs go up to the level of the upper-deck. The orlop-deck will be of wood, and 24 ft. above the keel. The main-deck will be of iron, cased with wood, and 9 ft. above the orlop. The upper-deck will also be of wrought-iron, and 7 ft. 9 in. above the main. She will mount 14 of the Armstrong 100 lb. guns. Pivot-guns fore and aft. Total armament 36 guns, each throwing 100 lbs. Cost of the hull about £200,000:—of engines, about £75,000: fitting for sea, about £45,000 more—or, in all, £320,000.

The Two Great Atlantic Steam Liner Companies (the Cunard and Collins) distinguish their respective vessels by a different terminal letter in the name of each. Thus it is easy to perceive at a glance to which company any particular steamer of either of the rival undertakings belongs; for the Collins company christen their steamers by some name ending in C, as, for instance, the *Arctic*, the *Pacific*, the *Baltic*, the *Atlantic*, &c.: whilst their rivals adopt as their terminal, the first letter of the alphabet, as the *Acadia*, the *Asia*, the *Arabia*, the *Europa*, the *Persia*, &c.

The late North of Europe Steam Navigation Company, which started in 1852, with a paid-up capital of £444,760, according to their liquidators' recent report, will have a return to shareholders of only £44,476, with such further sum as may be produced by the sale of the factory at Lowestoft. The forced sale of the Company's steamers had not produced the sum anticipated.

For the Greek Government a contract has been taken by Mr. H. Pilcher, of Northfleet Dockyard, for the construction of a screw-frigate of 1,300 tons.

The "Prometheus" Paddle-wheel Steam-vessel has been completely reconstructed at Woolwich, and refitted since her last term of commission. On the 10th July ult. she was ordered to be removed from the basin to the harbour to proceed down the river for a trial trip, previously to being commissioned for immediate service.

The "Mersey" Timber Paddle-wheel Steamer, well known in the Dublin and Liverpool Cattle trade, the property of the City of Dublin Steam Packet Company, built at Liverpool in 1824, by Messrs. Motteshead and Hayes, register 195 tons, was recently towed up the Thames from Liverpool to be broken up. Her machinery, by Messrs. Fawcett and Littledale, was taken out at Liverpool.

The "St. George," 91, Steam-Ship was placed in dock, at Devonport, 8th July ult.: she is to have two additional streaks of copper.

The "Orlando," 50, Screw Steam-frigate, at Keyham, has had the rigging placed over her mast heads, and has received her coal.

The "Trafalgar," Screw Steam Line-of-battle Ship left Sheerness Harbour, 12th July ult., at 9·30 a.m., on a final trial of her machinery: the Admiralty authorities expressed themselves entirely satisfied with the results of the trial.

The "Camilla," Royal Mail Steamer (formerly on the mail station between Rio Janiero and River Plate) has been recently purchased for £12,000, by the Buenos Ayres Government.

The "Topaze, 84, Screw Steam-frigate, 14th July ult., made an experimental trip outside the breakwater (Hamoaze) to try her engines.

The "Vanguard" Sailing Ship, 84, is to be lengthened at Sheerness, and converted into a screw.

The New Screw Steam-vessel, "Lord Panmure," in the service of the Military Store Department of Woolwich, has been new caulked; and 16th July ult., commenced shipping 500 tons of shot and heavy war stores.

The "Repulse," 91, New Line-of-battle Screw Steam-ship, ordered to be laid down at Woolwich, on the new slip (or Crystal Shed), recently constructed, has been laid down on the blocks. Dimensions:—length between perpendiculars, 250 ft.; breadth of beam, 58 ft.; tonnage, $3,850\frac{10}{94}$ tons.

Two Timber Screw Gun Despatch Steam Vessels, ordered of Mr. W. C. Miller, Liverpool, shipbuilder, are in progress of construction. Dimensions:—length of keel and fore-rake, 145 ft.; breadth of beam, 25 ft. 4 in.; depth of hold, 13 ft.; tonnage, $449\frac{27}{94}$ tons.

The "Neptune," 91, Screw, underwent, 15th July ult., her first official trial steaming out as far as the *Warner* light-ship, and through Stokes Bay, finally bringing up at Spithead. Her second official trial of speed is postponed until she has received her lower-deck guns, powder, shell, &c.

Launches of Steamers:—

The "Delta," iron paddle-steamer, was, 2nd July ult., launched at Blackwall, by the Thames Iron Shipbuilding Company. Her dimensions, &c., are:—Length of keel and fore-rake, 314 ft.; breadth of beam, 35 ft.; depth of hold, 24 ft. 6 in.; tonnage, $1,909\frac{16}{94}$ tons; engines, oscillating, of 400 H.P., by Penn and Son, Greenwich, transferred from the *Valetta*, and refitted by the makers. Elliptic stern, with sham galleries. Is now fitting out at Deptford.

A Handsome Screw Dispatch Gun-Boat, for the Turkish Government, was, 2nd July ult., launched at Northam, by Messrs. Money, Wigram and Sons, Shipbuilders. Engines by Messrs. Maudslay, Sons and Field, of Lambeth. She has a falcon figure-head, round stern, with mock galleries.

An American War Steamer, "Sloop No. 1" (for such, it appears, is her name), was lately launched at the Philadelphia Navy Yard. She is one of eight provided for by an Act of the last Congress, six being built in the places severally designated—viz., New York, Boston, Portsmouth, Norfolk, Pensacola, and San Francisco. All are to be propellers, but in the one in course of construction at San Francisco, Sloop No. 1, is thee first off the stocks. She was commenced about the middle of September, but the weather delayed it. Her length is 208 ft.; beam, 33 ft. 2 in.; depth of hold, 14 ft.; burthen, 1,200 tons. Will draw about 8 ft. water. Her model indicates speed, her bow being rather of the clipper build. Engines made at the foundry of Messrs. Merrick and Son, to be of 1,000 H.P., as large as those of the *Lancaster*, to be (by contract) completed within three months from the day of launching. Will carry two 11-in. pivot-guns, each gun, with the carriage, weighing 25,000 lbs., and two 32-pounders—weight of each of these guns, 5,700 lbs. From drawings by Mr. Grice. Superintendent, Mr. Hoover. Built entirely of white oak.

Casualties to Steamers:—

The Leith Screw Steamer "Dunedin," bound for the Port of Hamburgh, with passengers and general cargo, was, on the night of the 5th July ult., in collision with the *Lady Alice Lambton*, screw-steamer, outward bound. The *Dunedin* immediately went down in six fathoms water. The accident occurred off Gsti. Crew and passengers saved.

The "Argo," American Screw Steam-ship, which sailed from the Port of New York on the 23rd June ult., for Galway, *viâ* St. John's, Newfoundland, has been wrecked at Trepassy Bay, Newfoundland, and will prove a total loss. Passengers and crew all saved.

The "Alma" Steamer [Peninsular and Oriental Company], on her voyage from India, ran ashore at 3 a.m. on the 12th June ult., and was wrecked on the Harnish Rocks, a coral-reef, about 70 miles inside the Straits of Babelmandel, in the Red Sea. Crew, passengers, and mail saved, having (after three days' exposure on an adjacent island) been relieved on the 4th day, by Her Majesty's steamer *Cyclops*. Amongst the passengers rescued was Sir John Bowring, the late Governor of Hong Kong.

The Steamer "Dunedin," from Leith, which sunk off the Ooke, 5th July ult. [see above] has [advices from Cuxhaven 8th July ult.] been found near Otterndorf. A pointed buoy, painted green, has been laid out, to the south of the ship; and a flat-buoy to the north of her. It is feared the attempt to raise her will prove of no avail, and she is considered as lost.

The "Kars," Iron Screw-Steamer, which sailed recently from Constantinople for Alexandria, is supposed to have been lost, not having been heard of since the 28th May last. She had 300 passengers on board.

The "Sillestria," Iron Screw-Steamer, foundered at sea, 23rd June ult., on her voyage from Alexandria to Constantinople. Seventy-seven passengers lost.

The Running of the Austrian Lloyd's Steamers [suspended during the late blockade of the Mediterranean ports] was to re-commence, according to the preliminaries of peace,—to Venice, 11th July ult.—to Constantinople, 23rd July—to Smyrna, 26th July—and to Alexandria, on the 11th August. All the captured Austrian steamers are to be given up.

The New Steamer "Paramatta," of 3,092 tons (B.M.), and 800 H.P. (Royal Mail Steam Company), has been wrecked on her voyage from Southampton to the West Indies, with the mail of June 17th ult. Crew, passengers, and mail saved. The *Magdalena* left the *Paramatta* on the 2nd July ult., "badly stranded on the Arinegada Reef, near St. Thomas's." She was completed only a few months since, by the Thames Iron Shipbuilding Company; and cost £160,000. Unless this magnificent steamer can be got off, the loss will fall entirely on the company, who insure their own vessels.

MILITARY ENGINEERING, &c.

Pontoons.—The pontoon-bridge, thrown across the Ticino on the morning of the 4th June ult., is described as a model of strength and lightness, and is found to resist the heaviest burden. On the 17th, thirty-five rifled siege pieces, all 12-pounders, equivalent to the old 24-pounder, crossed over easily. The range of these pieces is $4\frac{1}{2}$ kilometres, making more than $2\frac{1}{2}$ miles; they are drawn by four horses.

Captain Grant's New Military Cooking Apparatus, for benefiting the soldier on the march or in the field, was (28th June ult.) tested in the Royal Arsenal, Woolwich. The apparatus (which consists of a spacious oven, stewing and boiling cauldrons, and a huge cylindrical soup-machine, supplying 150 gallons of soup) weighs $11\frac{1}{2}$ cwt.—in working condition 1 ton. On this occasion, it was mounted on an ordinary artillery waggon, drawn by the couple of horses, and drawn over the roads and thoroughfares of the Royal Arsenal. About 500 labourers belonging to the carriage department were served with a quart of vegetable soup, and a ration of meat each. A batch of bread, as well as some large pieces of mutton and beef), drawn from the oven, with samples of the soup, &c., were laid on a table in the pattern-room (recently erected) for the verification of the Committee, who unanimously pronounced in favour of the excellence of the apparatus. The fuel consumed, also, stowed in the sides of the artillery-waggon, was 150 lbs. of rough wood, of a kind easily obtained in any country.

Use of Balloons in Warfare.—The "Patrie" states that a new plan of reconnaisance has just been adopted (by the Allied Army) in order to ascertain the position of the enemy (Austrians). The brothers Godard arrived at Castenedola, followed by two or three artillery-waggons, bringing all the *matériel* for an ascension. After examining the country, from the top of a church-tower, and studying the map of the surrounding country, they obtained permission from General Fanti to ascend in the balloon from a meadow in the plain of Montechiaro, assisted by the French Engineers, and some of the Piedmontese soldiers, placed at his disposal by the authorities, one of the brothers, in less than half-an-hour, had filled his balloon, made arrangements for holding it to the same spot, and ascended to a height of about half-a-mile. He reported that during his rapid voyage in the air he had seen nothing (no hostile preparations, we presume); and that for two or three leagues beyond Montechiero there were no Austrians, unless they were concealed by plantations, or in the inequality of the ground.

A Handsome Chinese Gun has recently been sent to the Keyham steam-yard, where it will be mounted.

The New "Chain Gun" [Freeby's] consists of a series of "chambers" (forming the "chain," whence the new weapon takes its name), each of which, containing a cartridge already capped, is brought, in its turn, into momentary connection with the barrel of the gun. This connection is so close while it lasts, that there is no escape of gas, and as soon as the trigger has been pulled, one movement of the left hand releases the discharged chamber, while the simultaneous act of raising the hammer brings a fresh link of the "chain" into its place. The process can be repeated so rapidly, that the whole number of chambers can be discharged in less than twice as many seconds—[Forty discharges in a minute are stated to have been attained in actual practice]. The time occupied in removing one "chain" and affixing another is inconsiderable, and the utmost rapidity of firing may be kept up without injury, heating, or fouling the barrel. The principle is applicable to any kind of fire-arm.

Twelve Gun Boats, on an improved principle, of 80 H.P. engines, and intended to be fitted with Sir William Armstrong's gun, are ordered to be constructed at the building-yard of Messrs. Scott Russell, Mare, Pitcher, the Thames Iron Works, &c.

French Landing Boats.—The "Journal du Havre" has recently announced that the (French) government has just made a contract, with private shipbuilders, for the construction of ten vessels of a particular kind, called "*Bateaux de debarquement.*"

French Rifled Cannon.—The system which appears to be definitively adopted, after repeated experiments, consists of three grooves about 3 in. broad, and 1-8th of an in depth, with a twist of 1-6th.

The [Long and Short] Enfield Rifle.—In the Commons, 19th July ult., in answer to a question whether the Enfield rifle alluded to in the War Office Circular of the 13th July ult., was the short rifle furnished to the Rifle Brigade, or the long rifle used in the line? Mr. S. Herbert said the latter was the one referred to; but he hoped at some future period to replace them all with short rifles.

Major Rhodes' Newly Invented Improved Military Tents have been practically tested by the authorities at the Horse Guards. The largest are about 30 ft. in length, 15 ft. in width, and 10 ft. in. height, of a kind of oval or vaulted construction, so that no part of the exterior presents a lodgment for moisture. The ordinary tent-pole is dispensed with; thus leaving the interior entirely free. His "Hospital Tent" weighs about 112 lbs. less than the old hospital marquee; and its whole cost is about £3 under the contract price. The "Field Tent for Troops" is of bell-shape, and about 10 ft. in diameter. Report speaks favourably of the new tents.

Portable Electric Telegraphs in War.—It now appears that the remarkable precision and unity of the French evolutions during the recent engagements with the enemy, were accomplished by quite a novel sort of flying aide-de-camps. From each corps, once in position, a horseman rode off to the next division, unrolling, on his rapid course, a light wire, which was, without loss of time, adapted to a field-apparatus; and the process was repeated all along the French line of 12 miles. Hence the movement of the whole army was known and regulated like clock-work. This arrangement had been planned in Paris, and a supply of gutta-percha covered metal-thread had been forwarded with secresy and despatch. This is decidedly one of the most ingenious of the modern scientific appliances of electricity to war purposes; the substitution for the old system of bearers of orders, of veritable "Electric Aide-de-camps."

A Special [Military] "Telegraphic Corps" operated in the rear of the allies, and laid wires as fast as any advance was made. M. Lair is the chief engineer; and the first Frenchman who entered Novara while the Austrians were scarcely yet out of it, was M. Gautier, of that staff, who set up his box, and telegraphed the details of the retreating corps at the moment they were outside the gates. Lonato, Montechiaro, and Castiglione, were in instant communication with Breschia and Milan, when evacuated by the Austrians on the 23rd June ult.

Pontoon Engineering.—The recent operation of [the allies] crossing the Mincio was provided for by Garibaldi, who is familiarly styled the "Pioneer-General of the Allies." He collected all over Lago di Gardia such a quantity of flat-boats as would suffice for laying half a dozen bridges over the river. These boats were continuously arriving on waggons and artillery trains, to the delight of the pontoon engineers.

The Fortifications at Mount Wise, Devonport, are to be strengthened. A breast-work, 6 ft. high, is to be raised on the redout, and two of Sir W. Armstrong's heavy guns are to be placed on the angles. The trench on the eastern side of the Parade is also to be filled in, and the ground of the latter will be extended as far as the Quarry by the Bluff Battery. The work has commenced at the Fosse.

The Expedition of Royal Engineers, charged by the Government with surveying and defining the boundary line between Constantinople and Montenegro has (10th July ult.) suddenly returned to the Royal Engineer Establishment, Chatham, after completing a portion only of the survey, the expedition having been put an end to in consequence of the war between France and Austria. Major Cox, R.E., in command of it, returned by the overland route: the remainder of the party are on their way home by sea.

Major Fitzmaurice's New Light for military purposes was, by order of General Peel, tested at the camp of Aldershott, at night on the 11th June ult. Every kind of signal was carried out, at immense distances: bodies of men were marched in and out, and were distinctly visible at 1,000 yards: the whole camp around was illuminated in a most beautiful manner, by sweeping the horizon with a single light.

WATER SUPPLY—(METROPOLITAN AND PROVINCIAL).

At Bristol a Series of Drinking-fountains, the gift of various gentlemen, and erected under the superintendence of the Local Board of Health, have just been opened for public use. Several others are in course of erection.

Railway Drinking-fountains have been put up at several stations (for instance, at Darlington, Stockton, and Middlesborough) along the Stockton and Darlington line. In the present hot weather, these fountains are much used by all classes of travellers, the thousands of Sunday-school children, and excursionists using them most abundantly.

The Central Reservoir of the City of Bordeaux, very full of water at the time, burst, on the evening of the 6th July ult., with such a tremendous noise, that the inhabitants of the quarter believed at first that the St. Medar powder mills had blown up. In a few seconds, the torrent of waters rushed in the direction of the Rue d'Arès and the Rue Judaique, carrying with it the ruins of many houses, furniture, beds, men, women, and children. The tocsin was sounded, and the local authorities, with the firemen, and troops of the garrison, hastened to the scene of the catastrophe. Late at night three or four dead bodies had been found; and about a dozen people, more or less injured, were in the hospitals of St. André and the Hotel Dieu. M. Devanne, the manager of the water-works, has since been suspended by the mayor.

The Fountain of the Place Louvois (Paris) has been covered with a copper-coating by the galvano-plastic process, which was tried with complete success on the fountains of the Champs Elysées last year.

Metropolitan Public Drinking-fountains recently erected or in progress: At the church of St. George the Martyr, Southwark; polished red granite, the water flowing from the mouth of a bronze mask, in high relief; gift of J. A. Pash and William Bear.

At Islington, the vestry have decided on erecting five fountains in their parish. At Camberwell Green one is to be erected forthwith by the vestry; for Peckham, Peckham Rye, and the Old Kent Road respectively, three others are under consideration of the committees.

At Edinburgh, the recent application by the Lord Provost's sub-committee to the Water Company for water to the town-fountains, free of expense, has been acceded to.

GAS ENGINEERING—(HOME AND FOREIGN).

Metropolitan Gas Supply.—A deputation, headed by Dr. Backhoffner, waited (6th July ult.) on the Home Secretary, to state certain grievances in connexion with this subject, more especially as regards the alleged monopoly exercised by the various gas companies, since 1857, by means of their so termed "districting" arrangement, in most cases leaving, by arrangement, only one company to supply the district: further that, in many cases, the price (for gas supply) had been considerably raised, &c. Sir G. C. Lewis said, he would investigate the subject, and endeavour to form an opinion as to the merits of the case.

"Benzine," as applied by M. Vaudoré, the inventor of a new process to increase the brilliancy of gas, has been lately tried at the Mobille Gardens, Paris, with, apparently, but indifferent success, as the magistrates have recently had to adjudicate on the complaint of one of the consumers of the new [alleged] improved benzinized gas, which, instead of burning brighter as promised by the contractor for the supply of gas, was materially reduced in brilliancy by the addition. The inventor of the improved process attended, and offered to repair the fittings. This offer was accepted; and here for the present the matter rests. The "Benzine" in question is the well-known very volatile preparation from gas-tar.

The Sale of Gas Bill was (11th July ult.) read a second time in the Lords.

The Plymouth and Stonehouse Gas Light and Coke Company have reduced the price of their gas to 3s. 9d. per 1,000 cubic feet, and intimate the possibility of a further reduction.

HYDRAULIC ENGINEERING.

A New and Powerful Fire Engine for the benchers of the Temple, has, on trial, been found to project a stream of water over the flag-staff of the Temple Church from within the quadrangle of the building. The engine is capable of discharging half-a-ton of water in a minute to a height of 130 ft.

The Long-stroke Pump [Improvement] of Mr. L. B. Schafer, of Baltimore, Maryland, recently patented, consists in the application of the "lazy-tongs" principle to the raising of the piston-rod of pumps. The end of the handle, instead of being fixed directly to the piston-rod, is attached to one link of the lazy-tongs, and the end of the piston-rod to the link furthest from the body of the pump. The difference between the distance travelled over by the handle and by the piston, varies, of course, according to the number of links in the tongs.

A Patent Hydraulic Purchase Machine for Cronstadt Slip Dock has been completed by Messrs. Moore and Son, engineers, Montrose Street, Glasgow. The slip which is now erecting at Crondstadt has an incline of 1 in 32; and the hydraulic machine, which is to be used in drawing vessels up the slip is capable of overcoming a force of 3,000 tons of dead weight. The principal feature of the purchase is a hydraulic cylinder, fastened securely to a firm foundation, at the upper end of the slip; it is fitted with a moveable ram, working through cupped leathers at the neck. Two side-rods proceed from a cross-head on the end of the ram, along the sides of the hydraulic cylinder to a tail-plate, to which are also fastened the traction rods connecting the purchase with the cradle on which the vessel is to be drawn up. Three force-pumps, worked from the engine-shaft, pump the water from the pump-cistern and force it into the hydraulic cylinder. A large discharge-pipe, with a powerful cock and lever, allows the water to be again returned to the cistern—the water being used over and over again. A back weight, attached by a chain to the top of the ram, descends into a recess in the foundation, and gives the ram the reverse stroke when the discharge-cock is opened. The cradle having been run down the inclined plane or slip, and the ship blocked up upon it, the traction-rods, which are usually of the same length as the stroke of the ram, are then attached to the cradle, and to the purchase-machine at the head of the slip. The steam-engine is then set in motion, when the pumps force the water from the cistern into the hydraulic cylinder, the pressure of which forces up the ram, and draws up along with it the cradle with the ship upon it. When the ram completes its stroke, the first traction-rod is disconnected, and the discharge-cock opened, when the back-weight instantly draws back the ram, ready to take hold of the next rod, which, being attached, the ram immediately again ascends, and so on, the hauling up being continued till the vessel is properly on the slip. The machine was dispatched 4th July ult., to Granton, thence to be shipped to Cronstadt, Russia.

HARBOURS, DOCKS, CANALS, &c.

The Steam Crane belonging to the Birkenhead, Lancashire and Cheshire Junction Railway Company, at Birkenhead, has been purchased by the Mersey Harbour and Dock Board (23rd June ult.), for the sum of £1,000.

The Revenue of the Liverpool Docks, as reported to the meeting held 23rd June ult. (surplus arising from the various dock warehouses), for the last half year, amounted to £33,500, being a considerable increase on the previous six months.

Canal to Unite the Atlantic and Mediterranean.—In our last Number we had occasion to notice this proposed undertaking as in contemplation. It now appears that Mr. Boyd has obtained the approbation of the Spanish Government for his scheme for this canal, to be carried under the southern side of the Pyrenees. This immense work is to extend from Bilboa, in the Bay of Biscay, to the Bay of Alfaques, in Catalonia, and will be 340 ft. in width, 30 ft. in depth, and 285 miles in length.

Table Bay.—The Harbour, or Breakwater, has, according to late advices from Cape Town, fallen into difficulties.

The Mouth of the River Tyne is being defended at various points, the armament of Clifford's Fort having been already completed. These defensive measures have been taken at the instance of the South Shields Council, who have recently addressed the Secretary for War on the necessity of providing security for the important trade of the river.

The Madras Irrigation Company's affairs are progressing. On the 30th June ult., £5,894 was paid into the Indian Treasury to the credit of this Company, making, with the other payments of a like nature, already effected, a total of £324,958 received by the Secretary of State for India in Council from this Company, on account of its capital, of which only £1 per share has been called up.

Royal Dockyards. [New Works, &c.]—In the Navy Estimates for this year, is included a sum of £647,411, for new works, improvements, &c., in the [Dock] Yards, &c.

The Northfleet Docks.—The promoters have resolved to abandon this project, owing to the inadequate support afforded by the public.

At Victoria Harbour, Durham, the improvements are progressing slowly. Two-thirds of the outer quay wall finished, and deepening operations going on. About 180 men are employed; but it is understood 100 additional hands will be put on as soon as the nature of the works will permit. Contractor, Mr. Wilson.

The London Docks Report, at the recent half-yearly meeting, attributes the falling off in the company's receipts to the powerful competition of the Victoria Docks and private wharfingers. The number of loaded ships, from foreign ports, that entered the docks during the six months ending the 31st May last, was 425, measuring 191,833 tons, against, in corresponding period of 1858, 458, measuring 195,223 tons. Earnings of the six months, £210,381 15s. 1d., against £234,966 14s. 5d. in 1858. The stock of goods in the warehouses on 31st May, consisted of 85,520 tons; at the corresponding period of 1858, it was 117,976 tons. The company have recently spent a million of money in the construction of a new dock. The existing scale of dues and charges, it was stated by the chairman, will have to be revised, in order to cope with the opposition of the Victoria Dock Company, whose due and charges are, in some cases half, and in others a quarter of those of the London Dock Company's; that the Victoria Docks have obtained a virtual monopoly of the tobacco trade, by charging 4s. for that which this and other dock companies have been in the habit of charging 12s.

The Ryde New Pier is gradually emerging from the steam ferry works. The piles are of iron, fitting into a screw like the bottom of a gimblet, and turned into the soil to the depth of 8 ft. They are placed 15 ft. apart across, and 20 ft. apart, to the distance of 1,000 ft. The pier is to have a carriage-road of 18 ft. with a footway on each side of 15 ft.

For the New Graving-Docks, at Birkenhead, the plans have been laid before the Mersey-Dock Board. The works will be proceeded with when the great float is run dry. The estimated cost is £200,000.

Coast and Harbour Lights.—The *Vivid* steamer, having on board the members of the Royal Commission appointed to inquire into the management and efficiency of the coast and harbour lights of the United Kingdom, left Portsmouth on the 5th July ult., in the direction of the Channel Islands. The commission comprises Admiral Hamilton, Capt. Ryder, R.N., and Mr. S. R. Graves, of Liverpool, Professor Gladstone, and Mr. John Campbell, secretary.

The East and West India Dock Company's Accounts, at last half-yearly meeting (8th July ult.), show a satisfactory state of affairs, notwithstanding some diminution in the "shipping tonnage received within the docks" as compared with the first six months of 1858. The total decrease is about 11,000 tons. Stock of goods in Company's warehouses is below that at corresponding period of last year, consequent, says the Report, upon the decrease in shipping. Export business continues to improve. Railway communications with these docks have been completed, and the Blackwall Railway Company's agreements for working the lines perfected, arrangements having been made for erecting the necessary buildings in the neighbourhood of each dock, as depôts for goods. The East and West India Dock Company was the first to encourage railway companies to form branch lines in connection with the various docks.

Docks in relation with Railways.—Before docks themselves were established the whole of the [modern] dock business was transacted by "wharfingers," who had certain privileges and facilities, but on account of the great robberies that were committed on the Thames (which robberies sometimes amounted to £1,000,000 annually), the docks were started. The compensation paid to the wharfingers for the consequent loss of these facilities (in addition to allowing them free access to the docks) amounted, in some cases, to £40,000. At present, practically speaking, the various dock companies have to keep up locks for the convenience of the wharfingers, who are not obliged to pay for the use of them. The subsequently suggested, and now daily-increasing, connection of railways with docks, bids fair to remedy this practical grievance, which presses more or less heavily on most dock undertakings.

The Panama [Isthmus] Canal.—The Board of Trade, Whitehall (8th July ult.), notified that the Right Honorable the Lords of the Committee of Privy Council for Trade and Plantations had received through the Secretary of State for Foreign Affairs, a copy of a despatch from Her Majesty's Chargé d'Affaires in New Granada, enclosing copy of a decree of the government of that Republic, authorising the executive power to enter into a contract for the construction of an interoceanic canal across the Isthmus of Panama.

The Sunderland Dock [and Wear Navigation] Bill, was, 12th July ult., read a third time and passed the Commons. The Sunderland Dock Bill (No. 2) passed the Commons 21st July ult.

The Wirrel Water Bill passed the Commons 21st July ult.

In the Sutherland Docks, the Passing-tolls will, under the new management, be charged 2d. on the ships' register, not on the ship's burthen, as hitherto, being a considerable advantage to the owner. Steam-tugs are also to ply on the river without license or charge; and the extra due laid on ships lying in the dock for more than a fortnight will be abolished. Further, all ships will be able to leave the river, by the south suttel, without having to cross the bar, thereby saving time and tide.

In Portsmouth Dockyard a singular accident occurred at night on the 18th July ult. to a ship (named the *Sunbeam*) placed on the "gridiron" to get her copper cleaned. By a sudden gust of wind, accompanying the thunder-storm, the vessel was blown over on her beam-ends; fortunately the tide was at its full height. The ship, by the ready aid of the dockyard people, was righted, and but little damage sustained.

Harbours of Refuge.—Votes are required this year of £34,000 for Dover Harbour, £75,000 for Alderney, and £65,000 for Portland Harbour and Breakwater. The works are progressing satisfactorily. In the Commons, 22nd July ult., Lord Palmerston, in reply to a question on this subject, said, that the formation of harbours of refuge on our coast was an object of great importance; but it was calculated that the expense that would be incurred thereby would be about £4,000,000; and competent authorities thought they could not be completed but at a much greater cost; so Her Majesty's Government had no intention to propose a measure upon this subject during the present Session.

Malta Harbour.—The question of improving this harbour has been again agitated. In the Lords, 21st July ult., it was officially admitted that the accommodation in this harbour was insufficient. The Government, however, did not yet feel it right to take the responsibility of advancing an expenditure of some £180,000.

The Malltraeth and Corsdaugau Marsh Bill, passed the Commons 21st July ult.

The Tyne Improvement Bill received the Royal Assent, 21st July ult., as did also the following bills:—

Gateshead Quay Bill.
Greenwich and South-Eastern Docks Bill.
Forth and Clyde Navigation Bill.

The Greenwich and South Eastern Docks Bill was (11th July ult.) read a third time in the Commons, and passed.

Slip Docks were, formerly, principally used for the Merchant Navy, but now that the hydraulic-purchase machinery has been applied, there is no limit to the size of ships, which can be taken up on docks of this kind, since the largest steamships or ships of war can, by the aid of this powerful agency, be drawn out of the water, and placed high and dry, with nearly asmuch expedition as if they were mere tugs. Slip-docks, with the adjunct of the new machinery, are rapidly coming into use in Government Dockyards, instead of hydraulic docks.

The Cronstadt [Russian] Slip-dock is intended to be used for taking up the men-of-war of the Russian Navy, for repair and examination. The Russian Government also contemplate erecting docks of this description at all their principal naval stations; and similar docks, of very large size, are being made for other Governments, besides others of different sizes for private ship-building establishments, both at home and abroad.

The Chichester Harbour Embankment Bill was (15 July ult.) read a third time and passed, in the Commons.

Embankment, Land Drainage, and Reclamation from the Sea.—The Earl of Leicester has just completed the reclamation (from the sea) of 700 acres of the vast tract of low marshy lands, near the little Port of Wells, Norfolk. For this purpose, a great embankment, involving an outlay of £12,000, has been carried, for the Holkham side of Wells, in a straight line towards the sea, which is thus effectually, it is hoped, shut out from the land sought to be reclaimed.

The Malltraeth and Corsddaugau Marsh Bill was (19th July ult.) considered, and ordered for third reading in the Commons.

BRIDGES, VIADUCTS, &c.

The Westminster New Bridge Bill [to empower the Commissioners to acquire additional space for the western approaches] was brought into the Commons, 11th July ult.

The Victoria Bridge, Canada.—The deputation from Canada, was received, 25th June ult., by Her Majesty in the Royal Closet, St. James's Palace. The address, presented by the Speaker of the Commons of Canada, the Mayor of Quebec, &c., prayed that Her Majesty would be graciously pleased to visit Canada on the occasion of the opening of the Victoria Bridge in 1860.

Blackfriars Bridge—Proposed Alterations.—A plan for improving the present objectionable state of this bridge, is now in the hands of the authorities, viz., to remove the three central arches (which include the present defective ones), and substitute an elliptical arch of iron, of 280 ft. span, the existing piers being properly thickened to support it.

The Kaffre Azzayat Bridge Across the Nile, on the Egyptian Railway, near to Alexandria, was opened to the public on the 25th May last, with great splendour. Said Pacha, in person, being present at the ceremony, which was characterised by some curious religious and other observances. It is a malleable iron girder-beam bridge, nearly 1,400 ft. long, with eleven openings, two of which are 104 ft. each, and spanned by the swing-beam. The centre of the swing rests upon a foundation-pier, composed of six pillars of 10 ft. diameter each: the remaining eleven foundation-piers being of two piers, each 10 ft. diameter. These twenty-eight foundation-piers were sunk by compressed air, on Hughes's principle, to an average depth of nearly 60 ft. below the bed of the river; and to 85 ft. below High Nile; the internal pressure in the caissons, while sinking, ranging from 20 lbs. up to 34 lbs. on the square inch, in accordance with the depth in the ground, and height of the Nile. Time occupied in sinking these twenty-eight caissons, less than twelve months; aggregate length of that portion of them sunk below the bed of the river, 1,500 ft. Extreme width of bridge, 42 ft., comprising a single line of rail in centre, and a camel track on each side. Works have been in hand about two years and a half. Designed by Mr. Robert Stephenson, M.P.; contractor, Edward Price, of London; resident engineer, Mr. John McLarren.

London, Southwark, Blackfriars, Waterloo, and Hungerford Bridges, and the New Charing Cross Railway.—The Charing Cross Railway, after passing the angle of the north wing of St. Thomas's Hospital, will cross Wellington Street by an arch 18 ft. in height and 72 ft. in span. The road at Southwark Bridge will be crossed by an arch of the same height, and a span of 75 ft. Blackfriars Road will be crossed by three arches; one of 50 ft. span, with a height of 18 ft., and two side arches, each with a span of 16 ft. The whole of the line will be on a viaduct of arches. It will cross the Waterloo Road, about 100 ft. north of the present South-Western Railway Station, and will, after joining a junction with the South-Western Railway, cross the river to Hungerford Market. The cost of the line will be £800,000, including £179,000 for the purchase of Hungerford Market.

The New Pont au Change (Paris), on the right bank of the Seine, is advancing rapidly. To facilitate the clearing away of the mass of stones round the piers of the old bridge, lately interrupted by floods in the river, an immense dam has been thrown into the current, obliquely, so as to direct the force of the floods to the middle.

The Kehl Bridge over the Rhine [between Strasbourg and Kehl] is progressing favourably. The excavations for the foundation of the first great abutment have attained the depth of upwards of 23 metres. This undertaking is the first trial of a perfectly new system, and its success, will, it is considered, create a revolution in hydraulic works.

Victoria Bridge, Pimlico.—The foundation-stone of this, the first railway bridge over the Thames, within the Metropolis, has been laid. The superstructure will consist of 4 arches, each of 175 ft. span, formed entirely of wrought iron.

The Appointment of County Bridge Surveyor and Architect, for Durham county, has been conferred by the local magistrates on Mr. W. Crozer, C.E., the borough engineer for Sunderland. There were fourteen candidates for the office, vacated by Mr. Howison, lately appointed engineer to the county of Northumberland.

The Blackburn [Road and] Bridge Bill was, 15th July ult., read a third time, and passed in the Commons.

The Spon-end Viaduct, on the Nuneaton Railway, in place of the one which fell in some two years past, has been commenced. Contractors, Messrs. Dunkley, of Blisworth. Cost, £11,000. The embankment is to be continued as far as Sherbourne, where a stone arch, 20 ft. span, will be erected over the river. There will be a stone arch 40 ft. span, over the road at Spon-end. Intermediate arches to be of blue bricks, faced with stone.

For the Iron Bridge across the Rue Moreau (for the Vincennes Railway) the transverse girders are being placed in position.

Traffic on London Bridge.—In his evidence before the Charing Cross Railway Bill Committee, the Inspector of the City Police states that, on the 17th March last, an account of the traffic passing over London Bridge was taken, commencing at 6 in the evening, to 6 in the evening of the following day, and there passed over, during that time, 4,483 cabs, 4,286 omnibuses, 9,245 waggons and carts, 2,430 other vehicles, 54 horses, either ridden or led, making a total of 20,498 horses and vehicles; passengers in vehicles, 60,836; passengers on foot, 107,074; making a total of 167,910 passengers. This was a fair average traffic: but some days it was much greater.

The Burton-upon-Trent Bridge Bill was, 19th June ult., read a third time, and passed in the Commons.

MINES, METALLURGY, &c.

Gold-seeking in England.—From the "Moffatt Times" we learn that a gold-exploring expedition, provided with all the tools necessary for gold digging and washing, and accompanied by miners from Lead Hills, passed through Moffatt recently. The scene of explorations is to be the head of Moffatt Dale, and in the neighbourhood of St. Mary's Loch.

Gold in Panama.—The recent discovery of rich gold fields has been announced. If this news be true, there is here for adventurous British gold-diggers a field opened, within three weeks' reach of their own country.

Coal-beds of France.—According to the "Journal de Villefranche (Aveyron) such an extension has been given (by the Grand Central Railway) to the mineral resources of the Aveyron that, within the last few weeks, upwards of 10,000 tons of coal have been conveyed from the Bassin de l'Aveyron to Bordeaux. The same (local) paper even goes so far as to predict that, shortly, the Aveyron coal will be substituted for the English on the French sea-board.

Gold.—Peel River Mineral Company.—The last letters report that a party of fourteen Chinamen, working in the river bed, had obtained about £4,000 worth of gold; they had subsequently left, and their claim was then being worked by Englishmen. The prevailing opinion, however, seemed to be that it was only a "patch," and not likely to lead to further material success in that quarter; yet, at the same time, it showed what rich deposits exist in that gold field.

THE CANDONGA MINING ASSOCIATION is defunct. The surviving directors have resolved to divide the balance of assets remaining in hand, and the final distribution of 5s. per share is announced as payable to the registered shareholders who have paid the last call of £4.

THE SOUTH DEVON IRON AND GENERAL MINING COMPANY have made a call of 5s. per share.

THE DUTCH COAL MINE ESTABLISHMENT AT KALUNGAIR, in Borneo, has been totally destroyed in an insurrection among the native subjects of the Sultan of Banjermassing (or Banjerinassing), Batavia. The whole of the Europeans, 32 in all (including Mr. Thottley, an Englishman, and engineer to the Company to whom the mines belong, and his wife and children), have been massacred by the natives employed. The origin of the sad affair is at present enveloped in mystery.

COAL AND IRON-STONE MINES.—WEIGHING AT PIT'S MOUTH.—A petition, from Barnsley district, signed by 5,000 miners and others, for an uniform system of weighing the material at the pit's mouth, also for short time, and education of children employed in mines, was presented (15th July ult.) to the House of Commons.

THE EXPORTATION OF ENGLISH COALS TO FRANCE has enormously increased of late years. The parliamentary returns, commencing in 1831, and ending in 1858, show that, in the first named year, the exportation amounted only to 34,000 tons. From that period it has steadily increased with the growth of the French steam navy, more especially since 1853, when the French Emperor commenced the construction of 32 screw steam line-of-battle ships; and, last year, the exportation amounted to 1,325,380 tons.

COAL FOR MANUFACTURING PURPOSES.—THE LONDON COAL-DUES.—A deputation of members of Parliament and manufacturers waited upon the Chancellor of the Exchequer at the Home Office, 8th July ult., to urge upon his notice the grievance sustained by large consumers of coal for manufacturing purposes, in being subjected to the London coal dues; namely (by the London Coal Acts) for the payment of 1s. 6d. per ton, if residing within the 20 mile metropolitan radius. In Dublin, by an act of 1832, coal, used for manufacturing purposes, has the benefit of a drawback. The tax complained of was, by one of the deputation, a manufacturer, characterised as a direct tax on the trade and business of the country, there being some manufacturers who were paying as much as £1,000 a year for coal dues. To these representations, Sir G. C. Lewis gave no decided reply, and the deputation withdrew.

COAL-MINING IN BELGIUM.—According to a report lately published by the Belgian Government, for 1858, the number of coal-mines open and being worked in Belgium is 205: of which 191 are conceded, and 14 provisionally tolerated. They employ 754 engines, of, collectively, 37,951 H.P.; and give occupation to 72,577 workmen, whose salaries are, on the average, 2 fr. 36c. per day, reckoning 300 work days in the year. The coal raised amounted to 8,883,902 tons—total value 100,470,583 fr., at the average price of 11 fr. 93c. per ton. The (Belgian) consumption is estimated at 5,496,890 tons. Exportation 2,887,012 tons, divided as follows, viz., to France, 2,680,079 tons; Netherlands, 130,541 tons; other countries, 16,392 tons. State-dues, received on all the coal mines, 565,878 fr. 75c., exclusive of an additional charge of 15 per cent.

TUNGSTEN, a metal hitherto but little attended to, appears to be destined to operate a compete revolution in the manufacture of steel. It has lately been discovered that an alloy, of 80 per cent. of steel and 20 per cent. of tungsten, possesses a degree of hardness which has never been obtained in manufactured steel. This alloy works on the latter with great facility, and can even cut it. Experiments have been made with this new composition at Vienna, Dresden, Neustadt, Eurtswalde, and where considerable quantities of the alloy in question are, it is affirmed, being manufactured. Old mines have been bought up, with a view of extracting tungsten ore.

A NEW METHOD OF REFINING CAST IRON is, we understand, in use with complete success in the Farnley Iron Works, near Leeds. It consists in forcing steam and air, instead of air alone, into the refining furnace, whereby the quality of iron is greatly improved, more especially when it is intended to be made into boiler-plates.

METAL EXPORTS from England, in the month of May, for the last three years, according to Trade and Navigation Returns:—

	1857.		1858.		1859.
Pig iron	£203,153	....	£136,540	....	£ 75,556
Bar iron	285,099	....	197,480	....	234,821
Wire iron	18,012	....	20,061	....	19,218
Railway iron	439,902	....	392,268	....	524,949
Cast iron	73,401	....	90,980	....	86,152
Wrought iron	349,284	....	270,338	....	294,769
Steel, unwrought	78,906	....	59,112	....	78,198
Copper, unwrought	49,517	....	31,480	....	33,293
Ditto sheet and nails	152,156	....	125,381	....	104,308
Lead	70,643	....	43,902	....	60,408
Tin, unwrought	30,913	....	25,186	....	21,325
Tin-plates	151,280	....	144,770	....	139,121
Hardware and cutlery	354,489	....	280,974	....	327,512

NASMYTH'S STEAM-HAMMER.—Mr. Trotman publicly asserts, recently, that since the introduction of Nasmyth's steam hammer, the cost of anchor manufacture and of large forgings is reduced one-half, at least.

WORKING IN IRON.—An appeal, through the Press, is now being made on behalf of the aged surviving descendants of Henry Cort, the discoverer, as it is well known, of the arts of puddling, piling, welding, fagotting, and rolling iron, which inventions have, during the last seventy years, conferred an amount of wealth equivalent to £6,000 000 sterling, and given employment to 600,000 of the working population during the last three generations.

APPLIED CHEMISTRY.

SOLVENT FOR LIGNINE.—If a piece of copper be dissolved in ammonia, a solvent will be obtained not only for lignine—the principal of all woody fibre, such as cotton, flax, paper, &c.—but also for fibrous matters derived from animal substances, such as woollen and silk. By the solution of any one of these, an excellent waterproof cement is formed; and if cotton fabrics be saturated with a solution of wool, they will be enabled to take the dyes, such as the lac dye and cochineal, hitherto suited to woollen goods only.

A NEW PROCESS FOR ELECTRO-PLATING WITH SILVER has been announced by M. Masse. The novelty of the process consists in the possibility, by its means, of silvering non-conducting surfaces, such as glass, porcelain, earthenware, as well as metals, without other preparation beyond cleansing the surface. On glass, the deposit is perfectly pure, metallic, and brilliantly reflective (*miroitant*).

LIST OF NEW PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 18th March, 1859.

686. F. Potts, Birmingham - A metallic support for training, removing, and transplanting flowers or trees in gardens.

Dated 28th April, 1859.

1064. J. Kidd, Birkenhead, Chester—Sewing machines.

Dated 31st May, 1859.

1339. W. Smith, 18 and 19, Salisbury-st., Adelphi—Apparatus for raising and docking ships.

Dated 1st June, 1859.

1350. G. H. Cottam and H. R. Cottam, St. Pancras Iron Works, Old St. Pancras-rd.—Stable fittings.

Dated 6th June, 1859.

1381. T. Hyland, Manchester—Manufacture of gum or dextrine.
1383. J. Ferrabee, Phœnix Iron Works, Stroud—Improved machinery for forming bats of fleece or sheet sliver.

Dated 7th June, 1859.

1385. C. Porley, Manchester—Machinery for preparing to spin, and for spinning cotton and other fibrous materials.
1387. P. Salmon, Glasgow—Valves for pumps and other uses.
1389. W. H. Dorman, Winchester house, Old Broad-st., and C. Cowper, 20, Southampton-buildings, Chancery-lane—Traction and locomotive engines.
1391. J. Greenfield, 8, Speedwell-st., Oxford—Fastenings for dresses and other like apparel.
1393. F. Muir, Paisley, N.B.—Ornamental or colour printing.

Dated 8th June, 1859.

1395. C. de Bergue, 9, Dowgate-hill, London—Machinery for punching and shearing metal.
1397. N. Royer, Paris—Manufacture of wadded or quilted fabrics.
1399. C. W. Eddy, Kegworth, Leicestershire—Reaping machines.
1401. J. E. Asbby, Enfield—Sights for fire-arms.

Dated 9th June, 1859.

1402. W. Bumess, 2, Prospect-terrace, Brixton, Surrey—Steam culture machinery.
1403. G. Bartholomew, Linlithgow, N.B.—Shoes for horses and other animals.
1404. J. H. Tuck, 34, Great George-st., Westminster—Breakwaters.
1405. E. Welsford, Bona, Algeria—Tanning.

Dated 10th June, 1859.

1406. T. Greensbields, 11, Little Titchfield-st., London—Purifying gas and obtaining ammoniacal and other salts.
1407. M. J. Haines, Dursley, Gloucestershire—Manufacture of driving straps or bands.
1408. G. J. Farmer, Hampton-st., Birmingham, and G. B. Hardy, Alexander-place, Brompton, Middlesex—Stair rods and eyes or sockets.
1409. A. F. Haas, Camomile-st., London—Lamp and gas shades or glasses.
1410. F. Puls, Roxburgh-terrace, Haverstock-hill—Treatment of hydro-carbons.
1411. S. W. Tyler, Greenwich, New York—Harvesters.
1412. W. Sellers, Philadelphia—Ovens for baking bread or other substances.
1413. M. H. Picciotto, Finsbury-circus—Apparatus for producing or obtaining motive power.

Dated 11th June, 1859.

1414. W. Donbavand and D. Crichton, Manchester—Looms for weaving.
1415. J. James, Broadwell, Lambeth—Obtaining and applying motive power.
1416. F. Palling, Esher-st., Lambeth — Construction of lamps for the purpose of burning tallow or oils.
1417. T. F. Henley, Denbigh-st., Pimlico—Obtaining alcohol or spirit from rice and other grain.
1418. H. J. Nicoll, 114 to 120, Regent-st.—Trousers.
1419. A. V. Newton, 66, Chancery-lane—Fire-arms.
1420. F. A. R. de Beauregard, Paris—Generating steam.
1421. G. C. Ash, West View, Hampstead—Manufacture of artificial teeth.

Dated 13th June, 1859.

1422. B. Baugh, Salt's Patent Enamel Works, Bradford-st., Birmingham—Machinery for raising metals.
1423. H. L. Corlett, Inchicore, Dublin—Rails, and the permanent way of railways.
1424. O. Maggs, Bourton, Dorsetshire—Washing machines.
1425. A. Smith, 4, Stafford-terrace, Loughborough-rd., Brixton—Bleaching and purifying bees' wax.
1426. C. N. Kottula, Liverpool—A means of cleansing or purifying the Thames.
1427. J. T. Smets, Plagamen, France — Manufacture of vinegar from grain and other vegetable products containing saccharine matter.
1428. A. V. Newton, 66, Chancery-lane—Fitting of life and other boats.
1429. W. E. Newton, 66, Chancery-lane—Manufacture of piled fabrics.

Dated 14th June, 1859.

1430. G. Smith, Manor-rd., St. Mary's, Newington—Hat-bands.
1431. W. Brown, jun., and S. Bathgate, Selkirk, N.B.—Apparatus for carding and treating or preparing fibrous materials.
1432. J. Dixon, Bishopwearmouth, Durham — Puddling steel.
1433. J. Cowan, Barnes, Surrey—An improved soap.
1434. J. Wanshrough, Bridge-st., Southwark-bridge, and A. Bain, Clerkenwell-green —Effecting communications between parts of railway trains.
1435. A. McDonald, Manchester—Apparatus for punching patterns or devices upon metallic printing-rollers or cylinders.

Dated 15th June, 1859.

1436. E. J. Maumené and V. Rogelet, Reims, France—Using the "suint," or the portion soluble in water of the greasy substance found on the skin and hair of sheep, for the purpose of manufacturing potash.
1437. A. V. Newton, 66, Chancery-lane—Manufacture of polishing wheels, sticks, and tools.
1438. E. Humphrys, Deptford, Kent—Marine steam engines.

Dated 16th June, 1859.

1439. J. Taylor, Aberdeen—Planes for working in wood.
1440. S. Levy, Manchester—Hats, caps, or coverings for the head.
1441. E. T. Hughes, 123, Chancery-lane— An improved night-lamp clock.
1442. J. Luis, 1A, Welbeck-st., Cavendish-sq.—A new siphon meter for liquids.
1443. J. Luis, 1B, Welbeck-st., Cavendish-sq.—An apparatus for regulating individually the pressure, expenditure, and light in gas burners.
1445. W. Birkmyre, Port Glasgow, Renfrewshire, N.B.—Drying, treating, and preparing yarns or thread.
1446. N. C. Szerelmey, 6, Park-ter., Brixton-rd., Surrey—Preparing combinations of materials for preventing rust in iron and decay in timber.
1447. C. H. Waring, Neath Abbey, Glamorganshire—Safety lamps.
1448. C. Wilkinson, Slaithwaite, Yorkshire — Doubling or twisting silk, worsted, woollen yarns, or yarns from any other fibrous substance.
1449. T. E. Tallent, Southwark-bridge-road—Manufacture of leather.
1450. T. W. Jones, 35, George-st., Hanover-sq., Middlesex Stereoscopic glasses for single pictures.
1452. H. F. Smith, 4, Dale-st., Manchester—Manufacture of driving straps or hands.
1454. A. V. Newton, 66, Chancery-lane—Casting cylinders and tubes.
1455. J. Harmer, Wellington-villas, Brighton, and W. Parsons, Scotland-st., Brighton—Fire-arms.
1456. T. Cattell, 30, Euston-sq.—Manufacture of varnish and lacker.

Dated 17th June, 1859.

1457. T. Orrell, jun., Mill-hill, Bolton-le-Moors, Lancashire—Mules for spinning.
1458. H. Evette, Lisieux, France—A new system of bedding.
1459. E. T. Hughes, 123, Chancery-lane—Treating and decomposing fatty substances.
1460. W. H. Hammersley, Leek, Staffordshire—Stringeing, glossing, or finishing silk.
1461. D. Deas, Carneil, Fife, N.B.—Reaping machines.
1462. R. A. Brooman, 166, Fleet-st.—Generating anhydrous steam.

1463. C. F. Vasserot, 45, Essex-st., Strand—Construction of stereoscopes.
1464. J. J. L. Guiblet, 11, Wilmington-sq., Clerkenwell—Watches.
1465. A. V. Newton, 66, Chancery-lane—Improved means for assorting substances of different specific gravities.
1466. J. Combe and R. Smalpage, Leeds—Winding and spinning machinery.

Dated 18th June, 1859.

1467. J. Luis, 1B, Welbeck-st., Cavendish-sq.—Windmills.
1468. J. Cox, Wenlock-rd., City-rd.—Apparatus for cutting rags for paper makers.
1469. A. Jeffery, Commercial-rd., Limehouse—Giving rotary motion to projectiles fired from rifled fire-arms.
1470. R. Bradshaw, Camden-town—Rotary steam-engines.
1471. R. Harper, R. Stokes, and T. Walker, Derby—Manufacture of chenille bonnet wreaths and bonnet feathers.
1472. J. Firth, Heckmondwike, near Leeds, and J. Crabtree, Mill Bridge, Leeds—Manufacture of carpets.
1473. G. J. Parker, Church-st., Stoke Newington—Apparatus for giving alarm of fire.
1474. W. Clark, 53, Chancery-lane — Supplying furnaces with hot air.
1475. P. F. Aerts, London—Apparatus for lubricating railway rolling stock.
1476. J. Ransley, 19, Princess-ter., Islington—Brake for retarding railway carriages.
1477. J. Ransley, 19, Princess-ter., Islington—Omnibus.

Dated 20th June, 1859.

1479. J. Cox, Birmingham, and S. F. and M. Frankham, Walsall, Staffordshire — Spurs for military and general use.
1480. R. Laming, Hampstead—Purifying gas.
1481. C. L. J. Dierickx, Paris—Coining.
1482. J. Edwards, 77, Aldermanbury, London—Manufacture of iron rails.
1483. A. V. Newton, 66, Chancery-lane — Apparatus for blowing off water from steam boilers.
1484. A. J. Hawkes, Jewin-crescent—Triturating apparatus.
1485. W. Rowan, Belfast—Generation of steam.
1486. T. C. Clarkson, 56, Stamford-st., Blackfriars—Manufacture of boots.

Dated 21st June, 1859.

1487. A. P. How, 81, Mark-lane—Self-supplying distilling apparatus.
1488. G. Tompkins, Pontymister, near Newport, Monmouthshire—Coating metals.
1489. E. Gwyn, Islington—Breech-loading fire-arms.
1490. S. Gibbs, Eddington, Herne, near Canterbury—Apparatus for sluging horses and other animals.
1491. W. E. Newton, 66, Chancery-lane—Tailors' and other shears.
1492. J. Meikle, 79, Rumford-st., Glasgow—Coating iron ships with asphalte.
1493. A. Parkes, Birmingham — Manufacture of cylinders and tubes of copper.
1494. L. D. Owen, 192, Tottenham-court-rd. — Machinery for manufacturing bolts and nails.
1496. E. Oliver, King William-st. — Improved medicinal mixtures for the cure of rheumatism, cramp, sciatica, and such like complaints.

Dated 22nd June, 1859.

1497. R. Smith, Longridge, near Preston, Lancashire — Apparatus applicable to looms for weaving fancy fabrics.
1499. A. Barclay, Kilmarnock, Ayr—Steam hammers and pile driving machines.
1501. C. Clarini, New York, U.S.—Making wrought metal nails by machinery.
1502. W. Goulding, Leicester—Construction of ploughs.
1503. F. X. Kukla, 121, Pentonville-rd.—Projectiles.
1504. W. Russell, Leicester—Wheels for ploughs and carriages.
1505. T. Moore, Lupus-st., Pimlico—Knapsacks and messtins.
1506. J. Apperly and W. Clissold, Dudbridge, Gloucestershire—Wheels for carriages and engines.

Dated 23rd June, 1859

1508. J. Luis, 1B, Welbeck-st., Cavendish-sq.—A machine for corking bottles.
1509. C. F. Varley, 4, Fortess-terrace, Kentish-town, and C. J. Varley, 7 York-pl., Kentish-town, St. Pancras —Improvement in proving electric conductors.
1511. E. T. Hughes, 123, Chancery-lane—Manufacture of artificial sandstone.
1513. A. Prince, 4, Trafalgar-sq., Charing-cross—Alarum locks and latches.
1514. H. Doulton, Lambeth—Earthenware jars and bottles.
1515. A. V. Newton, 66, Chancery-lane—Springs for resisting sudden and continuous pressure.

Dated 24th June, 1859.

1516. W. Lister, jun., and T. G. Garrick, Sunderland—Ships' windlasses and other like apparatuses.
1517. J. Mills, Heaton Norris, Lancashire—Manufacture of keys and gibs.
1518. A. Chesneau, 29, Boulevart St. Martin, Paris—Paddle wheels.
1519. W. Clark, 53, Chancery-lane—Sewing machines.
1520. G. Redrup, Loughborough, Leicestershire — Machinery for the cutting of shives, bungs, and other pegs.
1521. R. Hornsby, jun., Spittlegate Iron Works, Grantham, Lincolnshire—Ploughs.
1522. P. Faure and J. Pernod, Avignon, France—An improved process for utilising the residues of madder in the manufacture of garancine.
1523. J. Drury, Exley, near Halifax—Steam engines and boilers.

Dated 25th June, 1859.

1524. T. Howard, King and Queen Iron Works, Rotherhithe —Condensing steam in engines where superheated steam is used.
1525. W. J. Sluce, Bethnal-green-rd., O. Murrell, Edward-st., Bethnal-green-rd., and W. Hudson, Hackney-rd., Middlesex—An improved method of generating steam.
1526. C. Wye Williams, Liverpool—Steam boilers.
1527. W. E. Newton, 66, Chancery-lane—Apparatus for exhibiting stereoscopic pictures.
1528. J. Roberts, Upnor, Kent—Filters.
1529. J. Boden, Portswood-rd., and W. Clark, Northern-rd., Southampton—Apparatus for superheating steam.
1530. S. Russell, Sheffield—Breech-loading fire-arms.
1531. W. Coppin, Londonderry — Apparatus for raising sunken and stranded vessels and their cargoes.

Dated 27th June, 1859.

1532. R. Dick, Toronto, Canada—Keeping accounts current in printed form, for addressing cards, circulars, papers, and periodicals of all kinds, with great rapidity, by the aid of a very simple machine.
1533. G. Wrigley, Chester, and T. H. Wrigley, Mossley, Yorkshire — Self-acting mules for spinning and doubling.
1534. D. J. Fleetwood, Birmingham — Improvements in shaping metals.
1535. R. Burton, Brooklyn, U.S.—Breech-loading fire-arms.
1536. G. Smith, Buttermilk Falls, Orange County, U.S.— —Primer for fire-arms.
1537. T. Leigh and J. Line, St. Mary Cray, Kent—Paper-making machinery.

Dated 28th June, 1859.

1539. W. E. Newton, 66, Chancery-lane—Variable cut off gear for producing expansion in steam.
1540. A. V. Newton, 66, Chancery-lane—Machinery for cutting corks.
1541. J. M. J. Baillie, 15, St. Mary Axe, London—Tanning hides and skins.

Dated 29th June, 1859.

1542. J. Nash, Mill Wall, Middlesex—An improved disengaging block.
1543. G. Hall, jun., Montrose—Reaping machines.
1544. A. McDougall, Manchester—Preparation of disinfecting and antiseptic substances.
1547. W. Wilkinson, Bayswater, and D. White, High Holborn—Apparatuses for burning gas and other gaseous fluids.
1548. I. Tirebuck, Windsor-court, London—Machinery for printing from engraved plates.
1549. W. J. T. Williamson, 37, Gerrard-st., Soho — Gas burners.
1550. G. Chapman, Rutland-st., Leicester — Knitting machines.
1551. J. J. Griffin, 119 and 120, Bunhill-row—Gas furnaces suitable for fusing refractory metals.
1552. G. Baker, Birmingham — Metallic lattice or trellis work.

Dated 30th June, 1859.

1553. E. Francis, Wrexham, Denbighshire—Apparatus for facilitating the making up or packing of sugar.
1555. R. Kay, J. Manock, J. Whittaker, and T. Booth, Heywood, Lancashire—Machinery for slubbing, roving, spinning, and doubling cotton.
1556. W. Bestwick, Salford, near Manchester — Crinoline steel for ladies' dresses.
1557. R. A. Brooman, 166, Fleet-st. — Lithographic and chromo-lithographic presses.
1558. L. Boigeol, Giromagny, near Belfors, France—Machinery for winding and twisting fibrous materials.
1559. T. Bell, Plaistow, Essex—Manufacture of manure.
1562. J. A. Wilkinson, Brooklyn, U.S.—Printing presses.
1563. W. Summerscales, sen., and J. Summerscales, Keighley, Yorkshire—Improved wringing and mangling machine.
1564. J. Bernard, Albany, Piccadilly—Boots and shoes.

Dated 1st July, 1859.

1565. J. R. Beard, Manchester—Manufacture of artificial whalebone.
1566. A. Jones, Blackburn, Lancashire—Apparatus for looming textile materials.
1567. B. Standen, Salford — Deodorizing and separation of fœcal and putrescent organic matters.
1568. A. Carron, 25, Little Moorfields, London—Loom for the manufacture of silk and other velvet.
1569. N. Ardaseer, Bombay, East Indies—Steam boilers.
1570. J. B. Howell, Sheffield—Treatment of iron.
1571. E. W. Carter, Rochdale—Apparatus for sewing.
1572. E. A. Wood, Victoria-terrace, Notting-hill, and M. D. Rogers, Bromley, Middlesex—Apparatus for raising and lowering boats.
1573. S. Fisher, Birmingham—Ordnance and projectiles.
1574. R. Royds and A. Harcourt, Woolston, Hants—Composition for protecting the bottoms of ships and other structures of iron.
1575. W. Riddle, Westbourne-terrace, Barnsbury-park, Islington—Advertisement show cards or boards.
1576. W. E. Kenworthy, Water-lane, Leeds—Purifying gas, and saving of lime in the said purifying.
1577. M. Bogg, Duggleby, near Malton, Yorkshire—Washing machines.

Dated 2nd July, 1859.

1578. C. H. P. Cook, Glasgow—Ventilators and ventilating flue or chimney-tops.
1579. R. W. Morville, Pendleton, Salford—Mechanism, or arrangements for suspending and securing window-sashes.
1580. T. J. Hart, Birmingham—Breech-loading fire-arms.
1581. C. G. Guy, Liverpool, J. Brough, and R. Cotton—Upright steam boiler.
1582. E. Fourmaux, jun., Provin—A new weaving loom.
1583. C. H. G. Williams, 32, Regent-sq., Gray's-inn-rd., —Dyeing fabrics and yarns.
1584. H. Hirsch, Berlin, Prussia—Screw propellers.
1585. H. Harris, Newport, Isle of Wight—An improved method of connecting together the parts of which bedsteads and other furniture are composed.

Dated 4th July, 1859.

1586. J. Simon, Paris, Passage des Petites Ecuries, No. 5—Zeiodelite, a kind of paste which becomes as hard as stone, unchangeable by the air.
1587. J. Hollingworth, Clyde Paper Mills, Eastfield—Machinery or apparatus for the manufacture of paper.
1588. R. Lane, Cirencester—Mills for grinding grain and other materials.
1590. R. A. Brooman, 166, Fleet-st.—An improved hemmer or apparatus, to be used in connexion with sewing machines.
1591. R. A. Brooman, 166, Fleet-st.—A cementing powder or mixture, and process for cementing, converting, refining, strengthening, and steelifying iron.
1592. A. V. Newton, 66, Chancery-lane — Apparatus for separating metals from their ores.

Dated 5th July, 1859.

1593. J. McIntosh, Glasgow—Manufacture of leather driving belts.
1594. W. Knapton, of Albion Foundry, Monkbar, and A. Aitcbison, Knottingley, Yorkshire — Manufacture of gas.
1597. W. E. Newton, 66, Chancery-lane — Apparatus for moving iron and other metals while the same is in process of manufacture at the rolls.
1599. J. Watkins, Cwmamman Colliery, Aberdare, Glamorganshire, and J. Pugh—Lubricating wheels.

Dated 6th July, 1859.

1601. J. Luis, 1B, Welbeck-st., Cavendish-sq.—An apparatus for washing wool.
1603. J. Horton, Dudley—A new or improved gas meter.
1605. S. B. Haskard, Wollaton-st., Nottingham——Manufacture of hook guides used in machines.
1607. L. Schwartzkopff, Berlin, and F. C. Philippson, Dusseldorf—Steam hammers, and machines for cutting files.
1609. J. T. Edmonds, Prestwood, Great Missenden, Bucks—Winnowing or corn-cleaning machines.

Dated 7th July, 1859.

1613. J. Knowelden, Southwark, Surrey, and D. E. Edwards, Upper Belgrave-pl., Middlesex—Hydraulic engines and pumps.
1615. Sir F. C. Knowles, Bart., Lovell-hill, Berks—Making iron castings.
1617. W. Robinson, Wembdon, Bridgewater, Somerset — Cask washing machines.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1444. L. Barroux, 10, Rue Mogador, Paris—Railroads.—16th June, 1859.
1451. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Kiln for brick and plaster burning— 16th June, 1859.
1453. E. A. Cutler, Connecticut, U.S.—Machine for making horse-shoes—16th June, 1859.
1500. G. T. Bousfield, Loughborough-park, Brixton—Apparatus for winding thread of cotton or linen.
1561. L. L. Tower, Massachusetts, U.S.—Machine for damping and wetting paper.—30th June, 1859.
1621. W. Waite, York-house, No. 48, Baker-st., Portman-sq.—Manufacturing bonnets, hats, and other articles, partly or entirely from the leaves of the palm tree. —8th July, 1859.

DESIGNS FOR ARTICLES OF UTILITY.

4180. June 14. Henry Spence, 33, Great Charles-st., Birmingham, "Economic Gas Regulator."
4181. „ 15. Cottam and Company, 2, Winsley-st., Oxford-street, W., "Cottam's Ventilating Manger Fittings."
4182. „ 16. The Permanent Advertising and General Agency Company (Limited), 78, Gracechurch-st., E.C., "Universal Advertising Medium."
4183. „ 17. James Heavens, 28, South Molton-st., London, W., "Safety Hunter's Shoe."
4184. „ 24. James Cornes, 104, Pool-sq., Sheffield, "Improved Cheesemaking Apparatus."
4185. „ 27. Henry Naylor, Barbridge works, near Nantwich, "The Engraver's Assistant."
4186. „ 29. John William Scott, Victoria house, Worcester, "Stud Button Shank."
4187. July 1. Cuthbert Harrison Thew, Whitehaven, "Draw Spring for Ships' Cables and Towing Lines."
4188. „ 4. John William Mott, Lea Bridge-rd., Clapton, N.E., "An India Rubber Tobacco Pouch."

FIG. 10.

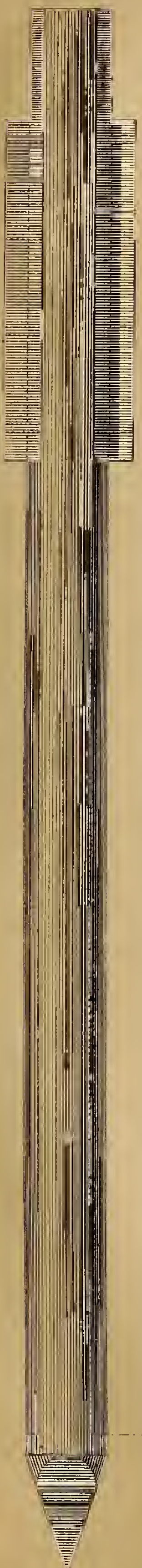


FIG. 1.

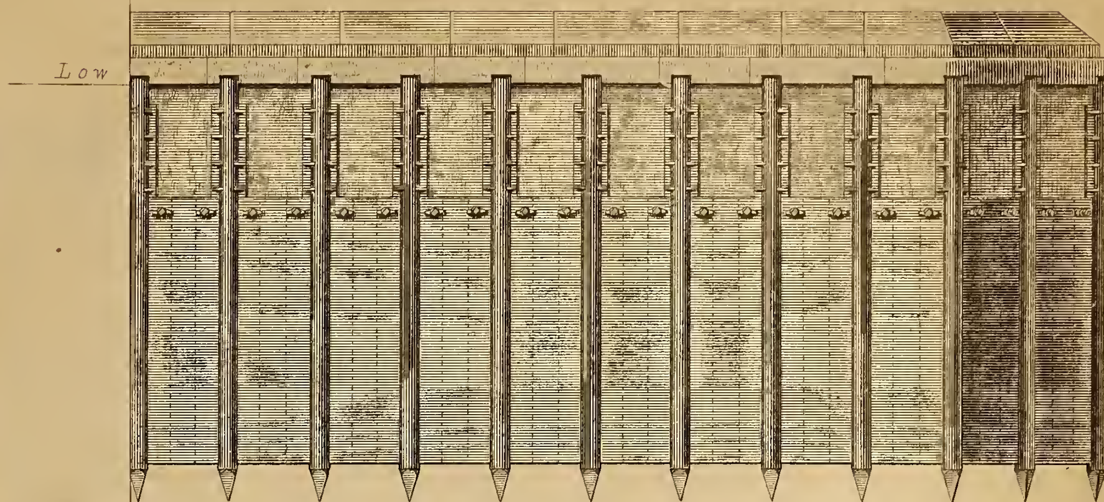


FIG. 4. Plan at A.A.

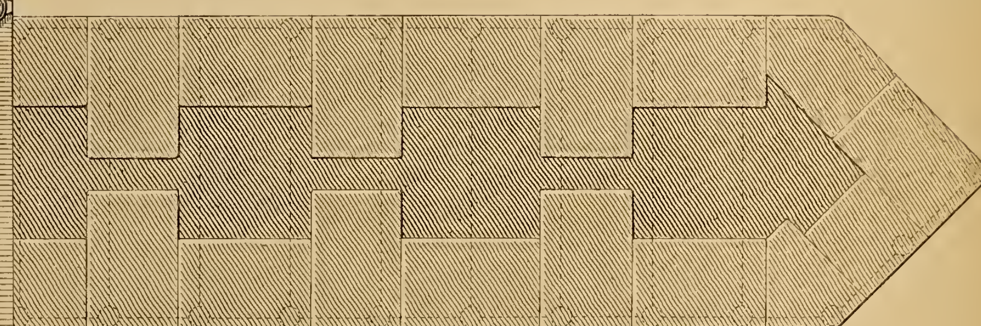


FIG. 5. Plan at B.B.

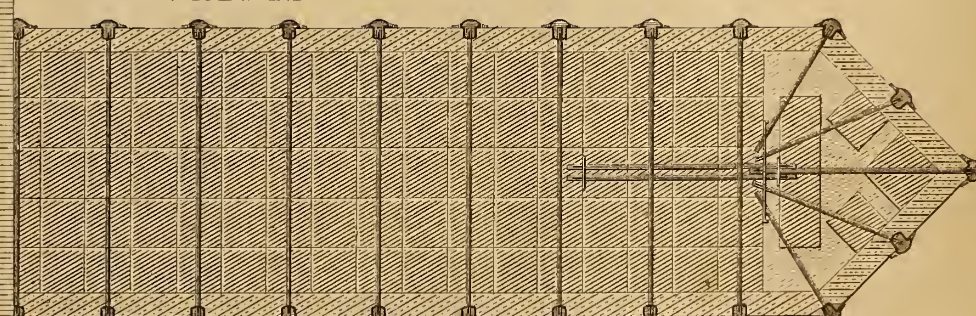
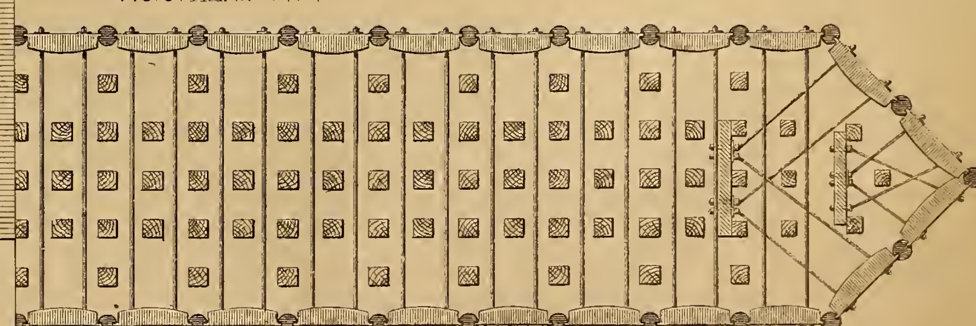
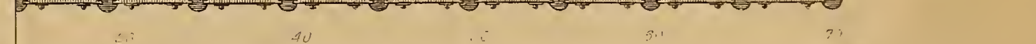


FIG. 6. Plan at C.C.





e to Figs. 1. 2. 3. 4. 5. 6.

V Smith C.E. direx

PLANS AND DETAILS OF PIERS

WESTMINSTER BRIDGE.

FIG. 10.

FIG. 3.

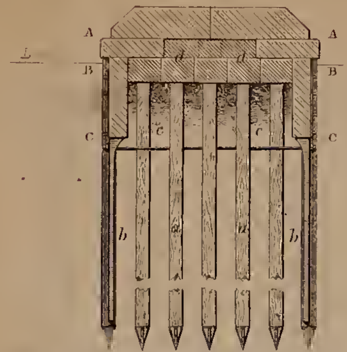


FIG. 2.

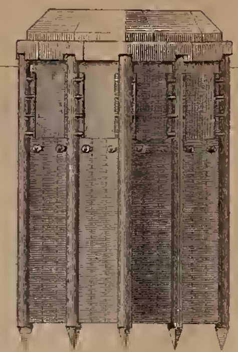
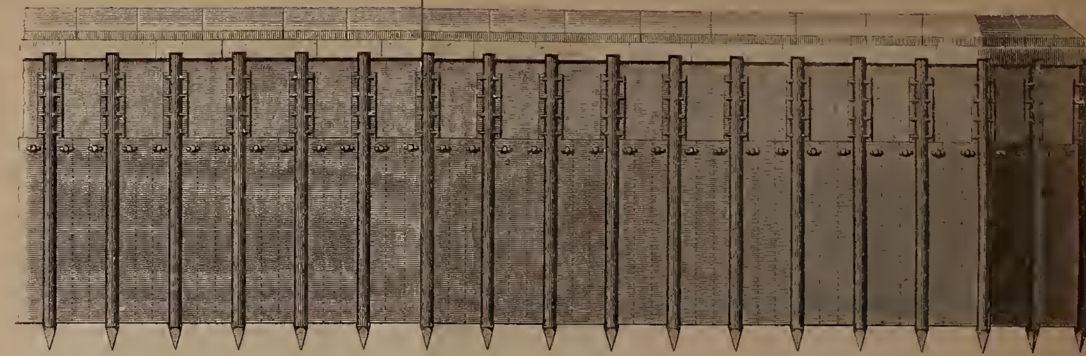


FIG. 1.



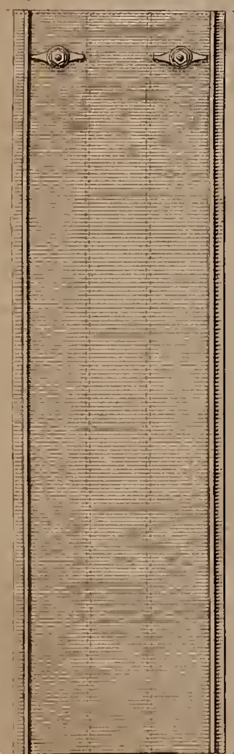


FIG 11

FIG 12

FIG. 7.

FIG. 8.

FIG 13.

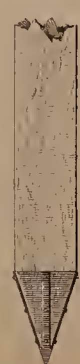


FIG 9. section at E.

Scale to Figs
7 8. 9 10 11 12 13
½ Inch to 1 Foot

FIG 4 Plan at A.A

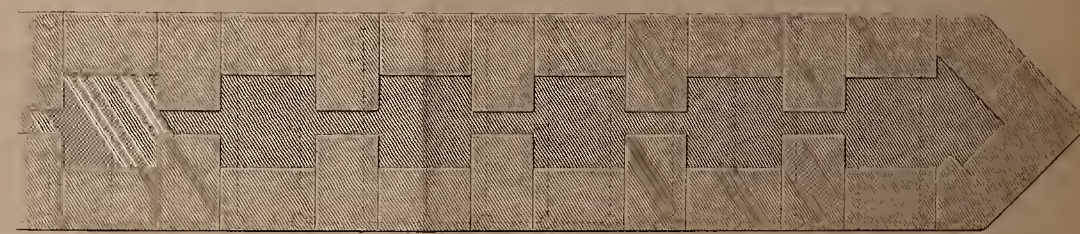


FIG 5 Plan at B B

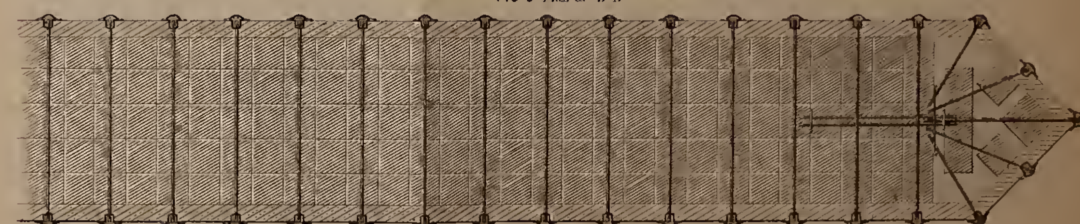


FIG 6 Plan at C C

Scale to Figs 1. 2 3 4 5 6.

THE ARTIZAN.

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STEAM ENGINEERING IN 1859.

APPLICATION OF STEAM AS A MOTIVE POWER.

In the preceding paper contained in the August number, the attention of the engineering reader was directed to the prevalent defects in the conveyance of steam through the pipes and cylinders; and it must be confessed that among practical men the most lamentable ignorance exists, and for the simple reason, that the evils referred to are not immediately evident. The cylinder and the steam therein make up their own accounts, and very few take the trouhle to investigate the halance.

A fall of three or four inches in the vacuum is sufficient to alarm the most indifferent engineer, but a loss of 30 per cent. hy condensation is not worth consideration.

Does the use of superheated steam economise fuel? The answer to this question must he in the affirmative; facts are stuhborn things, and we have just now ample proof that the economy arising from superheating steam is a fact.

Then, whence does this great economy of 20 and 30 per cent. arise? Is there some new and mysterious property given to the steam in the process of superheating? or can the improvement resulting be accounted for in an ordinary and common-sense way? We helieve it can.

The results arising from the use of superheated steam reflect severely and most justly on the positive ignorance of steam engineers. How is it that there is sufficient *waste* heat from the hoiler furnace in the present hoilers, to supply the additional heat to the steam? We excuse an answer, as there are so many other considerations intermixed with the question. One thing is quite certain, that if the exact *cause* of the economy is not understood, steam-ship owners, at least, appreciate the *result.*

As far as can he judged from the hest information and most reliahle experiments on the effect of supplying steam with heat in addition to that acquired in its generation, there is reason to helieve that the practical effect of such addition is simply to prevent the condensation in pipes and cylinders before referred to.

There are two facts connected with superheated steam that deserve especial attention.

The first is that steam, having a temperature due to its pressure, may, whilst in contact with the water, have an additional temperature of say 100° given it, so that the steam in contact with the superheated flue may be 350°, whilst the steam and water helow it are only 250°.

The second fact is that superheating steam appears to have little or no effect on its pressure; thus we have seen steam of 250° superheated to 360°, with little or no difference in the pressure—indicating that superheating isolated steam does not, *per se*, give much increased power. The question that engineers have to decide is whether the fuel is best consumed in superheating, or generating steam.

Strictly speaking, we have no right to say so much on this subject, as it is at the present time quite an exceptional one; but we hail it as an omen of better times, and a great hlessing to steam engineers, tending to make them more reflective.

Steam-jackets or casings round the cylinders of steam-engines are also recommended to counteract the premature condensation of the working steam. With few exceptions their adoption has given increased duty for a given consumption of fuel; and, in fact, if there is a loss of 20 or 30 per cent. by premature condensation—a fact we believe fully proved—it is quite certain that a casing ahout the cylinder filled with steam of equal or higher temperature than that inside the cylinder, must of necessity prevent this loss. The question then remains as to the cost of supplying these casings; and here we undouhtedly require more definite and reliable information. Steam-casings being the exception, and not the rule, experimenters have been few and far between; and unless special arrangements are made, it is difficult to estimate the relative values of the power lost hy condensation in the casing, and the power gained by preventing condensation in the cylinder.

The amount of steam condensed in the casings is stated variously from 3 to $12\frac{1}{2}$ per cent. of the total steam generated; in no case has it been found to exceed $12\frac{1}{2}$; indeed, the average may he taken at much below that amount.

If, therefore, as has been proved heyond a doubt, the condensation in the cylinder amounts often to 30, and that in the jacket we will say to 10 per cent., the result is a saving of 20 per cent.

Again, in the cylinder the per-centage of condensation increases so rapidly with the increase of expansion, that the economy due to the increased expansion is almost neutralised; hence it is that we never have derived, and never can derive, from expansion in non-heated cylinders, the results that may be always ohtained when the normal temperature of the working steam is maintained.

In steam-casings the condensation is practically uniform at all rates of expansion, and is almost uniform in point of time. Not so the working steam; it makes all the difference whether 3lh. or 6lb. weight of steam is nsed per stroke; in the first case (in general terms) the condensation is 30, and in the second only 15 per cent.

With those who deny that steam-casings are economical, the reason almost universally given for that denial is, that it does not matter whether the condensation takes place in the casing or in the cylinder, as the *amount* is the same in both cases. This is only a rough and ready way of burking a suhject not understood.

If practice indicates opinion, steam-jackets have little to hope for from the present race of engineers. Nevertheless there are a few who at least will fairly set the question at rest by experiment before they form a decided judgment thereon.

Where money is plentiful it is freely spent, and the same may be said of fuel, with this difference—that, in the former case, a man does get something which he considers the value of his money, whilst with fuel we spend a shilling and obtain twopence as returned value.

It is quite unnecessary, even in 1859, to take any trouhle to prove that 1lb. of steam expanded in the cylinder will give out a greater power than 1lb. not expanded; and that the power obtainable from 1lh. of steam increases in a certain ratio with the expansion.

This remark brings us to the second point of our present subject—the *use* we make of steam in a steam-engine.

It must be admitted that the expansive property of steam has been generally appreciated, and of all improvements tending to economy, has had the most supporters; and yet even this most important branch of steam engineering is neglected by the bulk of those who supply and use steam-power. Is it not a fact that on land and sea an efficient expansion valve gear is the exception, and not the rule?

Pumping, waterworks, and some other large land engines, are often fitted with arrangements for expanding to any extent; but take the thousands of small engines from 6 to 60-horse power, and, as a general rule, they have no expansion gear.

In marine engines the neglect on this point is perfectly unaccountable, and most discreditable. When an attempt is made to expand, how is it done? Why, generally, either by the link motion, which is quite useless for large cylinders, if an expansion of four times is required; or by the cam and throttle, the latter often placed some distance from the main slide, with all the disadvantages of such an arrangement.

The introduction of the link motion is one of the few solid improvements of the present day; for, although it can only be considered as a step in the right direction, it has been invaluable as a mechanical arrangement, and has been *one* of, if not *the* chief cause of so much more attention to the economy of expanded steam. The marine engineer must regard the link, as a reversing gear, almost with positive affection; so handy, so certain, and at the same time such a fair apology, as the times go, for an expansion gear.

But the link will not enable us to expand the steam six, seven, eight, and nine times.

Before the introduction of double ported valves in marine engines, perhaps no cut-off could be more effectual than the additional slab slide on the back of the main slide, and worked by a separate eccentric, arranged with a segment to alter the expansion at pleasure; and this plan is increasingly adopted in land engines as simple and effective. We only mention it as a plan perhaps more generally approved than any other.

With the prospect of increased pressure and increased economy, a simple and effective expansion is a great desideratum. It is quite beyond the purpose of these remarks to do more than point out the want.

The naked truth is that the mass of steam-engines are *not* fitted with expansion gear, and the owners of such are spending a shilling where sixpence would more than suffice; the old story.

The link motion is better adapted for locomotives than any other description of steam-engine, but yet it does not fulfil the conditions necessary for the most profitable expansion of 150lb. steam.

Notwithstanding the convincing arguments of those who uphold that low pressure is more economical than high pressure steam, it is to be feared the tendency of the age is to go up the pressure scale as rapidly as vessels can be invented adapted for such increased pressure; and we have a conviction not easily removed that this tendency is a progressive one. A few years ago 10lb. per square inch was a high pressure for marine boilers; now 20lb. is the usual pressure in new contracts, whilst 25 and 30lb. are not uncommon; either, therefore, the low pressure advocates must be in error, perhaps through not having clearly ascertained the value of some x y in their calculations, or—sad alternative—our progress is retrogressive.

As far as our judgment and experience can be relied on, we hold the opinion that the full economy obtainable from steam as a motive power can only be realised by employing the highest pressure of steam compatible with safety; and we also believe this opinion is held so strongly by our first engineers that it will be exemplified in their practice to such an extent as improvements in the generators will permit.

The very method of designing engines prohibits much benefit from expansion. The diameter and length of cylinder is *first* decided on, and then a boiler is designed to fill that cylinder at least half full per half stroke; and as the boilers weaken by age, the pressure and expansion are reduced together, so that a disgraceful beginning has a miserable end.

This defect in designing is very frequent with marine engines, for, in consequence of salt incrustation, a reduction of the pressure is more certain and occurs earlier than in land engines.

The generator should be the starting-point of design; there should be no difficulty with a thoughtful and observant engineer in ascertaining what quantity of steam can be supplied of a given pressure, with a fixed rate of combustion, and a fixed ratio between it and the heating surface. Having fixed his rate of supply, he can, with the most undeviating certainty, decide on his revolutions, rate of expansion, capacity of cylinder, and actual power required. But no; this, the most easy, most rational process, is considered the most difficult, and your practical man tells you that to get a certain speed out of a ship, "if you have a 50-inch cylinder, you will do it." Do it? yes, as many an unfortunate shipowner has been "done."

Before leaving this part of the subject, it may be as well to allude to the advantages alleged to be derived from the combination of a high and low pressure cylinder; and it must be admitted that such engines have been more economical than ordinary single-cylinder engines. But why is this so? Is it in consequence of the two-cylinder arrangement? This has never been proved. The reason we believe to be simply this—that all double cylinders are necessarily, by their very construction, *expansion* engines; whereas the cases are rare in which the single cylinder is fitted to carry out the expansion to an equal extent. With an equal amount of expansion, the single cylinder should be the most economical; at the same time, the double-cylinder arrangement, although more complicated, has the most even motion during high expansion.

We have purposely avoided any theorising as to the realised increased duty from various rates of expansion, as such information can be obtained from many sources. By a proper use of the expansive property of steam alone we can effect a certain saving of at least one-half of the present cost of steam power.

Our next and last subject is connected with the disposal of the steam.

In locomotives and non-condensing engines the waste occasioned by the escaping steam will be in inverse proportion to the rate of expansion, and the abstraction of heat to raise the temperature of the feed-water. With reference to the latter, a saving of from 10 to 15 per cent. may always be obtained, by passing the exhaust through or over the feed-water; but even this simple arrangement is often neglected—indeed, it is so in the majority of cases.

In condensing-engines it is of great importance to reduce to a minimum the units of heat passed into the condenser; and here again we recognise the importance of extreme expansion and no premature condensation. Any defect that allows 2lb. of steam to do only the work of 1lb. is not only a first loss in itself, but ultimately it injures the efficiency of the condenser by admitting into it nearly the total heat contained in 2lb. of steam instead of only that contained in 1lb. Hence, it is a proved fact, that with superheated steam or steam-jackets much less water is required to condense a horse-power of steam.

In speaking of steam generation, we called attention to the apparent necessity of the loss arising from the escape of the heated gases, requisite for a draught; and now, in concluding our remarks on the disposal of the steam, we have to confess that the discharge of a large mass of heated water appears an unavoidable loss: we take only some 4 per cent. of it to feed the boiler, and the remaining 96 per cent. is wasted. The temperature of the feed-water thus supplied averaging 100°, *may* always be raised to 200° or more, by abstracting the heat from the brine, discharge, or scum, but it *is not*.

With steam of 20lb. a vacuum of 10 or 12lb. is an important addition, but it is questionable whether the addition of 10lb. to a pressure of 150 will repay the cost of fitting and working the air-pumps; all will depend upon the extent of expansion.

And now a word about surface condensation, and the advantages to be derived from its introduction into steamships.

It would be difficult to overrate those advantages. A saving of at least 20 per cent. of fuel—clean boilers—small air-pumps—regularity of feed—and, above all, the consequent introduction of high pressure steam.

It is matter of surprise and regret that such authorities as Mr. J. Scott Russell and Mr. Bourne should inform the young engineer that surface condensation is not sufficiently rapid. This is a bugbear that has haunted many, and tended to repress an improvement that *will not* be repressed. It is not for us to say how or when surface condensation will be generally introduced; we can only put, on the one side, the many advantages its introduction creates, and, on the other, the trifling mechanical difficulties to be overcome, to effect its adoption. And who will question the result?

Next month we shall allude to the mechanism of the steam-engine; and in the following number, conclude the series with a *résumé* of the whole points touched upon.

NEW WESTMINSTER BRIDGE.

The construction of the new bridge is, as we have shown in our last number, proceeding without the use of coffer-dams, which would have heen totally inadmissible with the present spans of this bridge, inasmuch as they would entirely have obstructed the navigation, have hindered the rapid progress of the work, because there could not have been more than one or two at a time in use, and have added seriously to the expense of its construction; all of which are completely and safely avoided by the employment of the present system.

When the work has progressed further, the bed of the river will be dredged to an even surface, deepening gradually from each pier to the centre of the waterway under the arch, and a good coating of concrete be laid around the exterior of the piers and the bed of the river, so that any inclination to scour will be effectually counteracted; from the present low water at the bridge and in the Pool, having only 8 in. difference, and the quality of the concrete being identical with that described in our former number, there can be little douht of its success, and we do not apprehend any danger from the strongest current ever likely to arise in the river.

In describing the iron hearing and sheeting piles, we omitted to state that both are a full inch in thickness, and are very fine and sound specimens of cast-iron work. Another feature in the formation of the piers of this bridge is, the absence of the timber platform on the heads of the piles so generally employed where piles are used, so that the only timber used is in the piles themselves, and the strain on them is in the direction of the fibre, or longitudinally, a direction in which they will support the greatest strain without injury or damage to the superstructure, it heing a well-known fact that these elm piles would hear, without permanent alteration, a compressive force of nearly 200 tons each; but from heing surrounded by, and embedded in, a mass of dense concrete where above the hed of the river, they are not likely ever to be subjected to anything like this strain. As far as regards durability, these piles heing protected from the air, we think the case of the piles of Old London Bridge give a fair example of what may he expected from them, for there, under similar circumstances, they have been found to he sound after the lapse of about 600 years.

It having been determined that the new hridge should occupy the site of the old one, but have double the width, and also that the erection of a temporary bridge must he avoided, Mr. Page proposed to erect one-half of the bridge first, and open it for traffic hefore taking down the old one, which enables it to fulfil all the purposes of a temporary structure during the progress of the new bridge, and avoids the large expenditure necessary if a temporary bridge had been decided on.

This plan is now being carried out, and when the first half is completed and opened for traffic the removal of the old hridge will be proceeded with, and when cleared away, the completion of the other half will be commenced, so that no time will have heen lost, and a large amount of money saved; presenting, in this instance, a striking example of the progress which has been made in the economy of such works of construction.

NEW AND CONCISE FORMULA, FOR EXTRACTING THE ROOT OF *ANY* GIVEN NUMBER OF *ANY POWER.*

By CHARLES HOARE, AUTHOR OF "INSTRUMENTAL CALCULATION," &c., &c.

BEING in constant practice with my new sliding rule, some curious and useful formulæ are frequently exhibited in its varied combinations; amongst others, the value and interest of the following method of extraction, from its general application to *all* roots and powers, were too evident to be neglected. I have, therefore, submitted my process to the investigation of those engaged in mathematical studies, who are pleased to express the most favourable opinion of its novelty and utility, the Root heing obtained often more readily than by logarithms, and entirely superseding the necessity for the usual complicated methods of evolution.

FORMULA FOR ALL POWERS.

Let a = the given number, b = the assumed root, x = the true root; Where $x^n = a$, (n) heing any power named.

$$\text{Then } x = \frac{1}{n}\left\{\frac{a}{b^{(n-1)}} + b\,(n-1)\right\} \text{ nearly or quite.}$$

This construction is based upon the slow increase of the root, compared with the expansion of the number, by which the error of supposition is adjusted hy the mean; for if $b = x$, then $x^n = a$, but suppose b — the quotient is + or b + the quotient is — which $b\,(n - 1)$ being added, restores.

Example of the process: Find $\sqrt[3]{\ }$ of 8 with its true root:—

$2^2 = 4)\ 8\ (2 + 4 = 6 \div 3 = 2$ reqnired root.
$b^{n-1} \quad a \quad b\,(n-1) \quad \frac{1}{n} \quad x$

RULE FOR ALL POWERS.

Divide the given numher hy any assumed root, *raised* to the next less power; to the quotient add the assnmed root, *multiplied* by next less power; divide the sum by the given power for a new root, with which repeat if necessary.

Example: Find $\sqrt[4]{\ }$ of 1. Try $1^3 = 1)\ 1\ ($
1
3
4) 4
1 root.

Example: Find $\sqrt[3]{\ }$ of 1728 assuming either 11 or 13:—

$11^2 = 121)1728$
14.28
22
3)3628
12.09 try 12

$12^2 = 144)1728$
12 True Root

$13^2 = 169)1728$
10.2
26
3)36.2
12.06 try 12

Example: Find cube root of 125 by trial root 4:—

$4^2 = 16)125$
7.81
8
3)15.81
5.27 try 5 or 4.9

$5^2 = 25)125$
True root 5

$4.9 = 24.01)125$
5.2
9.8
3)15.0
5.0 True root

Find the $\sqrt[3]{\ }$ of 10. 973903978085048; try 2·1 or 2·2 or 2·3, either being somewhere near the root of 10. Say 2.2:—

$2\ 2^2 = 4.84)\ 10.973903\ (2.267$
4.4
3)6·66
New root 2·22 try
2·22
4·9284) 109739039 (2·22666
4·44
3)6·66666
2·22222 True root.

Example: Find $\sqrt[5]{\ }$ of 6436314 try 20
20^4 160000)64363(40·22
80
5)120 = 24^4 = 331776)643631(19·4
96
5)115·4(23·08 try 23^4
= 279841)643631(23 exact root.

It is hoped that these examples will make plain to the reader what is considered to he most nseful to very many practical artizans whose acqnaintance with logarithms is limited; and it is believed that but little practice is required to enable any one familiar with elementary arithmetic to apply the formulæ in every instance.

AMERICAN RAILWAY BUREAU.

An urgent necessity has long heen felt for an organisation by which reliable information of the actual financial and practical condition of American railways might he obtained; and English capitalists largely interested in American securities have lately had under consideration the propriety themselves of having a paid organisation hy which they might be able to benefit hy the active progress of the public works of the United States without incurring the risk of heing victimised hy schemes in which their aid might be invoked hy specious and fraudulent representations or enthusiastic estimates.

Such an agency here would necessarily be expensive and incomplete. The Railway Bureau, however, has heen established in New York for the purpose of collecting all desirable information respecting the railways of America, and consists of a system of agencies throughout the country under the supervision of gentlemen whose professional position insures its completeness and worth. Charles B. Stuart, the consulting engineer, has conducted some of the most important corporate enterprises, and has had his reputation endorsed hy the Government of the State of New York appointing him State Engineer and Surveyor, and also by having received at the hands of the President of the United States a commission as Engineer of the Navy. Having filled these two offices, the highest of their characters in both the civil and naval branches of the profession, his opinions are necessarily of the most reliahle character.

Mr. Samuel M'Ebrey, the Resident Engineer of the Staff, has had, within our personal knowledge, experience of the most varied and flattering character. His employments and success in canal and railroad building, in naval architecture and management, and in waterworks, enahle him to hring to hear upon the subject an amount of special knowledge and tact that could only be ohtained hy the opportunities he has improved so well.

The Bureau has commenced the puhlication of a weekly journal, called the *American Railway Review*, in which will he collected and disseminated the information obtained hy the Bureau. It will furnish a history of the different lines, and will contain a reliahle report of the condition of every railway in the Union, which will furnish to its subscribers a safe guide for any transaction within the scope of its subject.

ON THE PARTITION OF THE CUBE AND THE CONSTRUCTION OF THE BEE'S CELL.

We have been requested to give insertion to the following communication, which originally appeared as a contribution to the *Literary Gazette*, and we do so with pleasure:—

Many years ago you inserted in your journal a paper of mine on the subject of an approximate geometrical quadrature of the circle. That approximation I afterwards succeeded in obtaining to within the $\frac{1}{3737}$ part of the side of the square sought, and the Royal Society on the 10th May, 1855, so far relaxed the rule adopted with reference to questions of this description as to admit the paper to be read, and a short account was inserted in their proceedings.

I am now anxious to announce that I have succeeded in dividing the cube into several geometrical solids, with which many definite and regular geometrical bodies may be constructed.

Perhaps one of the most curious is that of the hee's cell, which is in fact an elongated dodecahedron, and consequently the angles of the trihedral roof and base, respecting which so many learned investigations have been made, can he no other than those of the true geometrical solid.

Without the aid of diagrams it is not easy to make the forms of solids clear to the mind in a popular way.

A cuhe may be divided into 6 equal and uniform bodies in two different ways.

1st. By lines from the centre to the 8 angles of the cube, which will give 6 four-sided pyramids.

2nd. By lines from one of the upper angles of the cube, drawn diagonally to the 3 opposite angles, dividing the cube into 3 equal and uniform solids. Each of these solids heing halved forms a left and a right-handed solid. These 6 solids, though equal in solidity, differ so far in shape, as 3 are left-handed and 3 right-handed, in the same way as the hands of the human body.

Each of the 6 bodies ohtained by the second mode of partition may he divided into two of equal solidity and of similar shape. Two of these bodies, each being one-twelfth of the cuhe, may be so united as to produce the pyramid obtained hy the first mode of partition. Six of these bodies, each heing one-twelfth part of a cube, may he so arranged as to form the oblique rhomhoid.

For the present investigation we will not proceed further than the solid thus ohtained, heing the one-twelfth part of the cube. By this body, hy using a different numher and mode of arrangement, may he produced a variety of symmetrical geometrical forms, in addition to the following:—

1. The cuhe consists of 12 of these bodies.
5. The octohedron consists of 4 „
3. The oblique rhomhoid consists of 6 „
4. The dodecahedron consists of 24 „
5. The dodecahedron also consists of 4 oblique rhomboids—or 2 cubes, or 6 octohedrons.
6. The bee's cell consists of 7 oblique rhomboids or 42 half pyramids.

It is therefore evident that the hee's cell is an elongated dodecahedron.

It may be observed that the pyramid, or one-sixth of the cube obtained hy the first mode of partition, may he divided into four bodies, each of which is one-third of a cube containing one-eighth of the mass of the cnbe from which it was derived. So that, in fact, we may go on dividing and reproducing bodies of a similar shape, and still retaining the diagonal lines of the cuhe. How far this subdivision may he carried in nature, or how much further than our powers of vision go, I will not at present venture an opinion. We can imagine the commencing atoms may he infinitely small, when we rememher the wonders revealed by the microscope. Charles M. Willich.

25, Suffolk-street, Pall-mall. S.W.

[The above letter was originally addressed to the editor of the *Literary Gazette*, but we have been requested by the writer to republish it.—Ed. Artizan.]

ASSOCIATION OF FOREMEN ENGINEERS.

On the night of July the 6th ult. a numerous meeting of the members of the *Association of Foremen Engineers* took place at their rooms in the City. It had been announced that a paper on "Superheated Steam" would be read hy Mr. Galloway on this occasion; hut a disappointment awaited the expectant assemhlage, for the chairman explained that, late in the week, that gentleman had communicated the fact of his inability, from illness, to keep his promise. Mr. Newton, however, further stated that, at his urgent solicitation, a younger member had (at so short a notice that he felt ashamed of himself for having asked the favour) prepared a paper on a totally different suhject—namely, the Rifle. This intimation was received with considerable applause, and the routine business of the evening having been disposed of, the memher who had so zealously devoted himself to the interests of the society proceeded with his task. He commenced hy remarking that in times like the present, when our most eminent engineers were contending for the honour of introducing the most destructive weapons of warfare, including cannon, small arms, guns of heavy calibre, long rangers, hreach loaders, hreach loading carhines, &c., it certainly would not be uninteresting to say a little ahout "rifles" to the members of this association. It would be the Enfield Rifle Musket which he should more especially attempt to explain. He then went on to describe in clear and forcihle language the peculiar characteristics of the weapon about which so much has heen written, and enumerated the various parts of it, with their particular uses. It is to he regretted that the reader of this excellent paper objected modestly to his name being published in connection with it. On its conclusion a discussion ensued upon the extraordinary advantages arising from the rifling process generally, and in this Messrs. Ives, Stahler, Keyte, M. Jones, and others joined. A vote of thanks to the memher who had, with so short a time for preparation, produced so useful a hudget of information, was next accorded, the chairman, in putting it to the meeting, inviting other members to imitate his example.

It was arranged at this meeting that the anniversary dinner of the association, postponed through the demise at the commencement of the year of the lamented Mr. Sheaves, should take place on the 17th of September next, at the rooms in St. Swithin's-lane.

ROYAL INSTITUTION OF GREAT BRITAIN.

ON A NEW METHOD OF RENDERING VISIBLE TO THE EYE SOME OF THE MORE ABSTRUSE PROBLEMS OF CRYSTALLOGRAPHY, HITHERTO CONSIDERED ONLY AS MATHEMATICAL ABSTRACTIONS.

Rev. Walter Mitchell, M.A.

Charles Wheatstone, Esq., F.R.S., Vice-President, in the Chair.

The unpopularity of crystallography may he attributed to the difficulties so many people, especially those who have not had a good mathematical training, meet with in attempting to master the conception of forms involving some of the principles of solid geometry. To a certain extent this may he removed hy a well-arranged system of solid models: thus the first three propositions of the 15th hook of Euclid, "the inscription of a regular tetrahedron in a cuhe, of a regular octahedron in the tetrahedron, and of the octahedron in the cube," may he demonstrated to the eye by a dissected cube, illustrating the natural cleavage of fluor spar. Indeed, the cleavage of a cube of fluor spar is a natural demonstration of the three principal propositions of the last hook of Euclid's Elements of Geometry.

There are many propositions of crystallography which require some mechanical means heyond that of the use of solid models to make them appeal to the eye for clearer perception. The most perfectly symmetrical solid forms of the crystallographer helong to the cuhical or tessular system. There are seven different kinds or orders of forms belonging to this system, perfectly symmetrical; four of which admit of an infinite variety of species. These forms are associated in nature as well as in their mathematical relations to each other. They are found in crystals of the same suhstance, either in their simple forms or else associated in combination with each other, in the different faces of a compound crystal; thus the cube, the octahedron, and the rhombic dodecahedron, are found as simple crystals of the diamond, or faces parallel to all three or two of them, may be discovered on a more complex natural crystal.

The three forms we have just enumerated, the cube, the regular octahedron, and the rhombic dodecahedron, may be considered as the permanent or limiting forms of the cubical system; they admit of no varieties; their angles, whether those of the inclination, of adjacent faces, or of the planes constituting their faces, are invariable; they are also limiting forms. Between the octahedron and the rhombic dodecahedron we may conceive an infinite number of varieties of the three-faced octahedron, passing from the form of the octahedron to that of the rhombic dodecahedron; similarly, the octahedron and the cube are limiting forms of an infinite series of twenty-four-faced trapezohedrons, and the cube and rhombic dodecahedron of a series of four-faced cubes. The forty-eight-faced scalenohedron or the six-faced octahedron is a form varying within the limits of all the others.

To represent to the eye the passage of all the varieties of these forms between their respective limits is the object of the mechanical contrivance which is the subject of this paper. A skeleton or armillary sphere is constructed of iron wire, so as to mark out the principal zones of the sphere of projection of the forms of the cubical system; three circles are united at right angles to each other, so as to represent eight equilateral spherical triangles, each of whose sides are arcs of 90°. The six points where the arcs cross each other are the poles of the six faces of the cube; the lines joining each pair of opposite poles represent the cubical axes, each axis being perpendicular to two faces of the cube which can be inscribed in the sphere. Each arc is now bisected. These twelve points of bisection are the poles of the rhombic dodecahedron; the lines joining the opposite pairs of these poles are the rhombic axes, each of these axes being perpendicular to two faces of the rhombic dodecahedron inscribed in the spheres, or inscribed in the cube inscribed within the sphere. Let each of the eight equilateral spherical triangles be divided into six equal and similar spherical triangles by arcs, joining the angle of each triangle with the centre of its opposite side; the armillary portion of the sphere is now completed. The point within each of the eight equilateral spherical triangles, formed by the intersection of the three arcs by which it is divided, is the octahedral pole. There are, of course, eight of these; the lines joining the opposite pairs of these poles are the octahedral axes, each one being perpendicnlar to two opposite faces of the regular octahedron inscribed in the sphere, or in the cube inscribed within the sphere. If we now join each pole of the octahedron with the three poles of the octahedron in the three adjacent equilateral spherical triangles by straight wires, and do this symmetrically for the eight poles, we shall then have the edges of the cube inscribed within our armillary sphere. The octahedral axes joining the opposite solid angles of this cube, and the rhombic axes passing through the centres of each opposite edge.

Within this skeleton cube we now inscribe a regular octahedron, using elastic strings for its edges, by uniting the point where each cubical axis passes through the face of the cube, with the similar points on the two adjacent faces. Each face of the octahedron is therefore represented by an equilateral triangle of elastic cord. We now suppose each side of the eight equilateral triangles to be bisected. Every angle of the eight equilateral triangles is joined to the bisection of its opposite edge, by another series of elastic cords. We have now an octahedron inscribed, in the cube inscribed within our armillary sphere. Every face of the octahedron having marked upon it the traces formed by an imaginary plane passing through the zones of the sphere and its centre. It will now be seen that the cubical axes join the opposite solid angles of the octahedron; the rhombic axes, the bisections of its opposite edges; while the octahedral axes pass through the intersections of the elastic cords, which join each solid angle of the octahedron with the centres of the edges opposite to it.

The points where the elastic cords meet, and the octahedral axes pass through the faces of the octahedron, are now fastened to cords. These cords are made to run round pulleys and are united together, so that by pulling them simultaneously, the points uniting, every one of the three elastic cords which are described on the face of the inscribed octahedron can be made to travel uniformly and symmetrically along each of the octahedral axes from the face of the octahedron to the solid angle of the circumscribing cube. Another series of cords are united to each of the four elastic cords, which meet at the point bisecting each of the edges of the inscribed octahedron. These, by a similar contrivance, are made to draw these points along the rhombic axes. The instrument is now completed. By simply pulling the eight cords united together, which cause the elastic cords to ascend the octahedral axes, the inscribed octahedron passes through every form of the three-faced octahedron till it reaches the limiting form of the rhombic dodecahedron. Each three-faced octahedron being inscribed within the cube, inscribed within the sphere.

In a similar manner, by pulling the cords, running along the rhombic axes in combination with those running along the octahedral axes, all the other forms are shown as passing within their prescribed limits. As soon as the cords are loosened, the elastic bands immediately resume the form of the inscribed octahedron. In addition to these forms, the instrument also can be made to demonstrate the passage of all the hemihedral forms of the cubical system with inclined faces within their limits. In this manner it was demonstrated that this instrument can make visible to the eye all the changes and varieties of an interesting series of forms and their mutual relations, which could otherwise only be conceived by a considerable power of mathematical abstraction. This armillary sphere, by some other small additions, can be made use of for tracing out some of the most beautiful portions of the zone-theory of the poles of crystals.

ON THE ESTIMATION OF THE ORGANIC MATTER OF THE AIR.

Robert Angus Smith, Esq., Ph.D., F.R.S.

Sir Henry Holland, Bart., M.D., F.R.S., in the Chair.

After describing the opinions concerning organic matter in the air, and the various attempts made to estimate the amount, the lecturer described a method of obtaining the relative quantity by means of mineral chameleon, permanganate of potash or soda. This mineral had been proposed by Forchammer, as a mode of estimating the organic matter in water, but it was capable of estimating quantities much more minute. At first the air was passed through the solution of chameleon, but this was not found to cause complete action. It was necessary that the air should remain for some time in contact with the solution to be decomposed. It was then ascertained that the relative amount of organic and other oxidisable matter in air could be found by a simple metrical experiment in a few minutes.

The lecturer then said—In working out this idea, it has been found that a vessel of the capacity of 80 to 100 cubic inches is the most convenient. This is equal to rather less than a quart and a half and rather more than a litre and a half.

The solution of chameleon used must be extremely weak, so that small quantities cannot readily be distinguished by gaslight. 600 grains of it are required to decompose 5 grains of a standard solution of oxalic acid. The standard solution of oxalic acid is so made that 1,000 grains neutralise one grain of carbonate of soda. A thousand grains contain therefore 1·184 grains of crystallised oxalic acid.

To prepare the solution a manganate was formed by heating nitrate and carbonate of soda and manganese, assisted by a little chlorate of potash. There was the most minute trace of nitrate remaining in the solution. Perhaps chlorate of potash wonld have been better, but I had no idea at the time of the difficulty afterwards found in obtaining the same quality. A solntion of this manganate was made in pure water, and carbonic acid passed through until a reddish purple shade was obtained. It was then tested by oxalic acid, adding three or four drops of pure sulphuric acid. The purest water obtainable was added to dilute it to the proper amount. This often failed; and I have sometimes for a whole week failed to obtain the proper solution. Although I call it permanganate, it is not entirely so; it is a mixture of manganate and permanganate. A permangauate of the strength described has a dingy appearance and uncertain colour. I do not doubt that a pure permanganate of a suitable strength may be obtained pleasant to work with. There is some difficnlty in obtaining pure water for preparing the solution. If allowed to stand for some time with a manganate it becomes purified.

The solution of chameleon is apt to change, although slowly, even when it is hermetically sealed in a glass tube. The solution described had become nearly colourless when sealed up hermetically for about three months. It is found readily to change when it is exposed to air by frequent removal of the stopper of the bottle containing it. Its strength must be tested occasionally; and if it differs from the standard, a calculation must be made for its rednction. The strength of the permanganate solution is extremely small. A few grains of the ordinary solutions of manganese used will make some thousand grains of the solution here employed. The reason of this lies in the extremely small amounts of organic matter found in even the worst air.

The vessel used is simply a bottle, with a perforated stopper, throngh which pass two tubes. To one of these a stopcock is attached, to the other a clasp or stopcock. The standard size proposed is 100 cubic inches; and to this all the experiments have been reduced; the vessels actually used contain between 80 and 100 cubic inches of air. The stopcock is of glass, or of hard caontchouc, which is still better. When the bottle is to be filled with the air to be tested, the stopper is removed, and the pipe of an exhausting pump is inserted, reaching to the bottom of the bottle. The pnmp is made like a cylindrical bellows of abont eight inches long when stretched out, and about fonr in diameter, and is compressible into the thickness of abont two inches. The sides are made of thin Mackintosh cloth. By the use of the pump the air of the vessel is removed, and the external air of conrse enters. A few strokes of the pump are sufficient—*i.e.*, from six to ten. After ten strokes I perceive no change, and am inclined to think that it is an nnnecessary number. The test liquid is poured into a graduated tube or bnrette, containing somewhat more than will be required. A portion is then poured into the tube which passes through the stopper, and the stopcock is opened to allow it to pass. Small quantities are used; when it has entered the bottle, the liquid is made to spread over the sides, and time given it to be exposed to the action of the air; it is found that in five or six minutes a decided epoch is attained from which to date the comparative action.

In order to see the colour the liquid must be allowed to trickle down the sides of the vessel, and collect itself at one point of the circumference at either end of the cylindrical part of the bottle. This part must be raised up to the level of the eye so that the longest axis may be presented to the sight, and thereby the deepest shade of colour. It requires some time to accustom oneself to the sight of such a small amount of colour; but when it is once well observed, it will be found to be a method which will admit of the greatest precision. The first few drops which are poured in will probably be decolorised at once; a few drops more must then be added; if they become decolorised a few more must be used; and so on until there is a perceptible amount of colour remaining. When this occurs, the experiment is concluded. The amount of the reagent used is then read off from the graduated measure. If the liquid be of the proper strength, and the bottle the required size, the number of grains gives the comparative quantity at once. Sometimes the amount of organic matter is so small that there is no appreciable action, on even the smallest amount of solution by one vessel of air. In this case it is necessary to fill the bottle several times. The mode of doing this is apparently extremely rude, but the results are such as not to demand a finer method at present. A finer method, of course, would need little ingenuity to contrive. At present, I merely remove the stopper and fill again with air as before. During the period of filling the vessel the surface of the liquid is reduced to its smallest amount, and the change it undergoes is either inappreciable, or so constant as not to affect the results.

In analysing the air in this manner, it is found that a decided result is attained in about five minutes. Sometimes the result is decided in one: that is, there is a termination to the rapid action. This peculiarity is probably to be explained by the following experiments. If we pour decomposing matter on the permanganate solution, it is rapidly destroyed. If the matter be not in a state of decomposition the action is much slower.

These different results promise a mode of dividing the organic matter of the air into classes according to its quality. These facts are mentioned merely as germs of a future inquiry. In large towns, where coals containing much sulphur are burnt, the sulphurous acid takes the oxygen of the chameleon, and an apparently large amount of organic matter results. This sulphurous acid is of itself an impurity, perhaps as hurtful as some kinds of organic matter.

We measure by this means the amount of oxygen needful for the oxidisable matter of the atmosphere, and all such matter is impurity, in some places entirely organic, in others, such as towns, mixed with inorganic gases.

Some of the principal results obtained by this method were as follows:—

RELATIVE QUANTITIES OF ORGANIC AND OTHER OXIDISABLE MATTER IN THE AIR OF *

Manchester (average of 131 experiments)	52·9
„ All Saints, E. wind (37 experiments)	52·4
„ „ W. wind, less smoky (33 expts.)	49·1
„ „ E. wind, above 70° Fahr. (16 expts.)	58·4
„ „ below „ (21 experiments)	48·0
„ In a house kept rather close	60·7
In a pigstye uncovered	109·7
Thames at City, no odour perceived after the warmest weather of 1858	58·4
Thames at Lambeth	43·2
„ Waterloo-bridge	43·2
London in warm weather (six experiments)	29·2
„ after a thunderstorm	12·3
In the fields S. of Manchester	13·7
„ N. of Highgate, wind from London	12·3
Fields during warm weather in N. Italy	6·6
Moist fields near Milan	18·1
Open sea, calm (German Ocean, 60 miles from Yarmouth)	3·3
Hospice of St. Bernard, in a fog	2·8
N. Lancashire	about same
Forest at Chamouni	2·8
Lake Lucerne	1·4

The first experiments undertaken were in Manchester, and the average amount obtained was in the city about 50, gradually diminishing in moving towards the country until it was found in the fields at 13; on passing a sewer stream about a mile from the outskirts, the amount rose to 83. The atmosphere on the Thames was not measured whilst at its worst, but immediately afterwards; when, however, it had ceased to affect the senses of most persons at least, the amount was very high—viz., 58. I was anxious to know how far the Thames affected the atmosphere of London, and tried some experiments: the result was that the influence appeared to cease almost immediately; the fact of a block of houses standing in the way was enough to prevent the influence; when at the worst this may not have been the case; to arrive at the other side of the block the vapour would generally require to rise high, so that it would become mixed with a great deal of air. The amount obtained in a few trials in the streets of London was 22 to 34; going on to Highgate, the numbers sank from 33 to 24; on descending the north side of Highgate-hill a distinct change was perceived, the numbers being 18; the wind meantime was blowing from the city: the few experiments made in the fields in summer gave 10 to 12. The numbers 6 to 18 were obtained in Switzerland and Lombardy. The moist fields around Milan gave 18; when the water passes off the rice fields, producing the unhealthy season, I do not doubt that the amount will be much higher. It was not convenient for me to stay, nor to go farther to places distinctly infected with malaria. I was desirous of trying it in some of the hovels of the Vallois and the Val d'Aosta, but the weather being fine, and the people living much out of doors, the inquiry was not encouraging. The few experiments made did not give very striking results, whereas the lower parts of our own towns gave results most decided: I imagine the cause of this to be that a drier air does not allow the offensive matter to rise so readily. This fact has many ramifications, but it will explain several difficulties in our sanitary science. It is with the assistance of moisture that the organic matter is conveyed into the air.

Moisture itself, as may be supposed, does not produce any action on the test; one of the lowest numbers obtained was on the German Ocean, about 60 miles from land; the day was calm and clear. In the Straits of Dover, when the wind was blowing briskly from the German Sea, the amount obtained was very high, but as there was a slight spray the experiments were disregarded. About 8,000 feet high on the Alps, a dense fog showed also one of the smallest amounts obtained; the ground was entirely bare rock, and could not give out organic matter. The amount was 2·8.

The influence of height was very decided. In the higher grounds of Lancashire, near Preston, the numbers being from 2 to 4. A wind blowing down from the Mer de Glace gave rather more than at a lower point, although coming down the hill; a dry pine forest in the neighbourhood, although very fragrant, did not appear to raise the number. The influence of the sea and of height seem equally decided.

A few hasty experiments made in the hothouses at Kew led me to believe that there was less increase there than might have been expected, the amounts obtained being less than in London, but more than outside the houses, where it was cooler. At the same time weeks or months should be given, when only hours were allowed for the experiments.

The influence of heat appears to be to increase the amount, when there is moisture present.

The influence of dryness seems to be towards diminishing the amount.

The influence of great cold has not been tried yet.

The influence of rain in hot weather, to some extent of course a cooling influence, but chiefly a means of washing the air, seems most decided. After a thunderstorm and shower at Camden-square, the number, which was previously 31, fell to 12.

The influence of our towns, especially our smoky towns, is most decided also; it is easy to tell by this test, when in the outskirts of a town, whether the wind is blowing from the town or the country.

A distinct difference was always found between the front and back of Manchester houses: a similar difference obtained when a room had been inhabited for some time, and the difference was of course very marked when the smell of a sewer came into the house. I had a good opportunity of observing this in my laboratory last year.

It must be remembered that the numbers given for some places were obtained on one day of the year only, and we must be careful not to draw too many conclusions: we have yet to learn what kind of organic matter is wholesome and what is unwholesome. I believe that this is the next great point to be attended to; at present we are only becoming able to ascertain the gross amount. I feel this caution to be needful, lest the numbers should be used to prove too much.

At an early opportunity all the experiments made will be published; but we may already see the range of the action of this test to be so great as to make it promise to be of some practical as well as scientific value. Dr. Southwood Smith has observed that the facts on which sanitary economy are built are exceedingly difficult of comprehension by a large number of people, because the cause of the evil cannot be brought directly under the observation; if, however, any plan were invented of showing that these dreaded emanations existed even when the senses could not perceive them, belief would be easily gained, and the requisite carefulness would then take place. If the method explained be found to be no more valuable than this, it will at least not be reckoned among useless discoveries.

We may hope, however, that it will be found to prove not only that much of that which we have already known is true, but that many other now hidden things are true also; we may find that every wind will have attached to it its mark of unwholesomeness with respect to this test, and that every season also will have its co-efficient. It may also be found that changes of season or of condition of the air will be ascertained with much more certainty, delicacy, and rapidity than now. We may even hope to find some premonitory symp-

* A few of these results were published in the "Athenæum" during last summer. The present numbers are somewhat higher, being reduced, for the sake of uniformity, to correspond to a vessel of 100 cubic inches.

toms of disease in the atmosphere before it affects the human body; the exciting cause itself existing long before it has been able to take effect, so that useful precautions may be made in time, and an efficient defence prepared. At the same time no proof whatever has yet been given that a plague or any infectious disease can be estimated by it, although reason has been given for such an expectation, whilst the air over different fields differs enough to promise some knowlege of miasm.

But what is abundantly established and made clear to the eye is that the air of our large cities is sufficiently impure to account for much of their unhealthiness, and the air of our hills and seas and lakes sufficiently pure to account for its salubrity. It is to be hoped that greater consequences will follow in proper time; although this itself was needed to set at rest some questions which have cooled the enthusiasm of many in the cause of sanitary reform.

ON THE OSSIFEROUS CAVERNS AND FISSURES OF DEVONSHIRE.

William Pengelly, Esq., F.G.S.

The Lord Wensleydale, Vice-President, in the Chair.

The limestone districts of Devonshire abound in caverns. These are of three kinds—chambers, tunnels, and shafts; their walls being either lined, angular, corroded, or eroded.

The following caverns were briefly noticed by Mr. Pengelly:—The Pixies' Hole at Chudleigh, the Chudleigh "Cavern," the Ugbrooke fissures, the Ogwell Cavern, the caverns at Buckfastleigh, Oreston, Yealmpton, and Ansty's Cove, near Torquay; the celebrated Kent's Cavern, also near Torquay; the "Ash Hole," near Brixham; and finally, the recently discovered cavern on Windmill-hill, Brixham.

In November, 1837, some waste lands on Windmill-hill, Brixham, were sold, when a small piece was bought by a dyer named Philp, who immediately commenced quarrying, with the intention of building upon it. In January, 1858, the workmen came upon a hole, at first only the size of a man's hand, but which soon became large enough to permit Mr. Philp to enter. He proceeded as far as fifty feet, and brought out bones, of which he forthwith made an exhibition, and thereby attracted the attention of local geologists. The cavern was speedily visited by Sir R. I. Murchison, Drs. Falconer and Percy, Professor Ramsay, Mr. Prestwich, and other eminent geologists. The Royal Society granted 100*l*. as a contribution towards the expense of a scientific exploration of the cavern; additional sums were quickly subscribed; and a committee was formed to arrange and direct the course of proceeding.

Mr. Pengelly described the structure and formation of the cavern, and the mode of exploration adopted; and stated that there had been discovered in it a very considerable number of bones of animals, extinct and recent (the rhinoceros, ox-tribe, horse, cave-bear, hyæna, &c.), and also several well-marked specimens of the objects commonly known as "flint knives," and which are generally considered to be of human manufacture. Similar articles had also been found in Kent's Cavern, in a corresponding situation, namely, in the "bone-earth," with the bones of extinct and recent animals, beneath the floor of stalagmite. Many fossils from the Oreston fissures were placed on the lecture-table; and on the wall were suspended diagrams of the ground plan of the Brixham cavern, &c.

Mr. Pengelly briefly explained his views on the probable origin of caverns in general, and of the Brixham cave in particular; which he referred to—1st, The production of a line of fractures; 2nd, The chemical action of acidulated water, through such fractures; 3rd, The mechanical action of running water charged with rock débris, &c.

With respect to the chronology of the cavern and its contents, the speaker referred to the remains of the great herbivora, as evidences of the place having had a tropical or sub-tropical climate at the time of these deposits, and considered that whatever was the antiquity of the bone-earth in the cavern, the human period is as ancient. He thought that many facts concur to suggest a re-investigation of the antiquity of the human race; and he also considered it highly desirable to organise a system for the general exploration of caverns.

In the course of the lecture Mr. Pengelly alluded to the various papers which had been published on the Devonshire caverns—viz., Mr. Whidbey's Description of the Fissures at Oreston, near Plymouth, in the *Philosophical Transactions* for 1817. A paper on the Yealmpton Caverns, by Lieut.-Colonel Mudge, read before the Geological Society of London, March 23, 1836; Mr. Austen's paper on the Bone Caverns of Devonshire, read before the Geological Society, March 25, 1840; and the Rev. Mr. McEnery's "Cavern Researches," being principally a memoir of Kent's Cavern, which was long supposed to be lost, but recently discovered and published by Mr. Vivian, of Torquay.

The following list (revised by Professor Owen) of Fossil Mammalia found in the Devonshire Caverns, was suspended on the wall:—

EXTINCT SPECIES.	RECENT SPECIES.
Ursus priscus.	*Rhinolophus Ferrum-equinium*—Great Horse-shoe Bat.
Ursus spelæus—Great Cave Bear.	*Sorex vulgaris*—Shrew.
Hyæna spelæa—Cave Hyæna.	*Meles taxus*—Badger.
Felis spelæa—Great Cave Lion.	*Putorius vulgaris*—Polecat.
Machairodus latidens.	*Putorius ermineus*—Stoat.
Lagomys spelæa—Cave Pika.	*Canis lupus*—Wolf.
Elephas primigenius—Mammoth.	*Vulpes vulgaris*—Fox.
Rhinoceros tichorinus—Tichorine Two-horned Rhinoceros.	*Felis catus*—Wild Cat.
Equus fossilis—Fossil Horse.	*Arvicola amphibia*—Water Vole.
Equus plicidens.	*Arvicola agrestis*—Field Vole.
Asinus fossilis—Fossil Ass or Zebra.	*Arvicola pratensis*—Bank Vole.
Hippopotamus Major—Large fossil Hippopotamus.	*Lepus variabilis*—Norway Hare.
Megaceros Hibernicus—Gigantic Irish Deer.	*Lepus cuniculus*—Rabbit.
Strongyloceros spelæus — Gigantic round-antlered Deer.	*Cervus elephas*—Red Deer.
Cervus Bucklandi—Buckland's Deer.	*Cervus tarandus*—Rein Deer.
Bison minor.	*Cervus capreolus*—Roe Deer.
Bos longifrons—Long-fronted Ox.	

ON THE COLOURS OF SHOOTING STARS AND METEORS.

John Hall Gladstone, Ph.D., F.R.S., M.R.I.

Henry Bence Jones, M.D., F.R.S., Vice-President, in the Chair.

All are familiar with the smaller kinds of shooting stars, and most have observed those of a larger size which shoot across the sky like a rocket, and burst perhaps in a shower of sparks; many persons also have been witnesses of the grander displays called fire-balls, or bolides, and some few have seen those bright clouds that have occasionally appeared and rained down stones upon the earth. It is not certain that all these are connected phenomena, or that there is a solid nucleus to every shooting star; yet it is impossible to draw any exact line of distinction, and there is every gradation between the most striking and the most simple of these appearances. The investigations of scientific men have made us acquainted with many facts relating to these bodies: thus, their direction is never perpendicular to the earth, but more frequently almost horizontal, and though they fly from every quarter of the heavens, the majority come from that part towards which the earth is at the time moving; their velocity averages about 20 miles per second; their height above the earth is, of course, very various, yet the more brilliant fire-balls seem to begin their luminous course at somewhere about 40 miles above us; their size is probably small in all instances, although, from irradiation, they frequently appear to present a considerable diameter; they occur often in showers; and these showers have been observed to have an annual periodicity. At the present time these star-showers occur generally about August 10 and November 13, but at the end of the 11th century the most remarkable period was April 4; and those wonderful people the Chinese, who have kept records of showers of meteors since March 23, B.C. 687 (when Manasseh was ruling over Judah, and European history scarcely existed), tell of other periods, pre-eminent among which is July 22.

The meteorolites which fall from the sky are of two sorts; the stony, consisting of silicate of magnesia, with more or less admixture of lime, potash, or soda combined with silicic acid; and the metallic, consisting of iron, which always contains a small quantity of nickel, with phosphorus and sulphur, and often contains in addition cobalt, and zinc, tin, lead, manganese, or chromium, with carbon or chlorine. Other elements have also been mentioned as found in certain meteoric stones. Three specimens were exhibited; a broken piece of silicate interspersed with metal, which fell at Triguerre, in France, and a huge mass of supposed meteoric iron, the property of Prof. Tennant; and a fragment of a piece of iron found in Mexico, now in the Royal Institution, and which, from its chemical composition, is believed to be meteoric.

The cosmical theory is the only one capable of explaining the known facts of these meteorites, though that is not without its difficulties. It supposes that in the interplanetary spaces, at least near the earth's orbit, there are a vast number of minute solid bodies revolving round the sun, either singly or in streams, and that our globe in its passage comes into collision with some of these, or periodically cuts the orbit of these streams of planetary dust. The small pieces of solid matter are supposed to become incandescent or ignited by their rapid friction against the air.

As to the colour of meteors, we have much information given in the lists of the Chinese, in those of the Rev. Baden Powell, published in the reports of the British Association, and in those of M. Coulvier Gravier. M. Poey, of Havannah, has taken the trouble of arranging all these observations according to the colour, and the month of appearance; and the totals of his tables form the basis of the accompanying table, in which, however, a little liberty has been taken with the classification, all the recorded colours heing referred to the six principal divisions of the prismatic spectrum, and these comhined with white, and white itself. The Chinese colour observations are rather under, and the English rather above a thousand, but for the sake of comparison they have been reduced to that proportion.

	Chinese.	English.	French.
Red	5·1	12·2	4
White-Red	0·5	4·9	6
Orange	56·8	10·5	4
Yellow	0·6	14·2	7
White-Yellow	0·5	1·8	1
Green	0·0	0·6	0
White-Green	0·0	0·6	1
Blue	0·8	30·8	0
White-Blue	32·7	5·4	41
Purple	1·0	0·5	0
White	2·0	18·5	3
Total	100·0	100·0	67

The very apparent dissimilarities in these three lists are capable of more or less explanation. The Chinese mention orange (or rather yellowish red and reddish yellow) meteors in great numbers, but these seem to be balanced in a great measure by the numerous observations of red, pale red, and yellow, as well as orange in the English and French lists. It should be remembered that there may be every gradation from red through orange to yellow, and it may be fairly open to doubt whether the inhabitants of the Celestial Empire gazing at the stars one or two thousand years ago distinguished colours just as their French translator would do. Again, the Chinese and French give white-blue in great numbers; but this is evidently the same as the English blue. The English lists also make numerous mention of white meteors, because in Prof. Powell's Catalogue the fact of a meteor being white or colourless is usually noted, which is not generally the case with either the French or tbe Chinese observations. The number of Freuch meteors classified as white-blue is swollen by many described by M. Coulvier Gravier as "white becoming bluish in the horizon."

The points of similarity in the three lists are, the small number of green meteors—what there are occurring generally among those fire-balls that change colour; the small number of purple; the ahsence of brown; and the fact that the large majority of meteors exhibit some distinctive colour. They may be generally divided into two groups, the one blue, the other orange, inclining more or less either to red or yellow.

If these appearances are really produced by the passage of pieces of stone or iron through the earth's atmosphere during its annual course round the central orb, it is very possible that the stream of little bodies that intersects our orbit at one time of the year may differ in composition from those that cut our path at another period. It occurred to the speaker that this might be evidenced by a difference of colour during their combustion, and that the monthly tables of M. Poey afforded the means of determining whether such was really the case. On examining the Chinese record it was found that the prevailing colour of a great shower of falling stars is very rarely given; the colour observations are almost confined to large single meteors; and little can be observed beyond the fact that the blue meteors are more numerous in comparison with the orange during the months of August, September, October, and November, than during the rest of the year. M. Poey has also made the remarkable observation, that the Chinese meteors "sbow a remarkable constancy of tints during a long period of years, when an equally constant but different scale of colour prevails, and this for several successive periods;" a fact that may possibly be due to the changes in the periodical showers already adverted to. If, however, we turn to the monthly tables of the English observations, we are at once struck with the marked difference in the relative proportions of the different colours. Thus, confining our attention to the months of August and November, when the great showers occur, we observe a difference that cannot be attributed to mere accident. In the followiug table red and white-red have been added together, yellow and white-yellow, blue and white-blue:—

	August.	November.
Red	49	24
Orange	8	23
Yellow	44	16
Blue	164	30
	265	93

On glancing at these numbers, we cannot fail to remark the great deficiency of orange meteors in August, and their comparative abundance in November, while conversely blue meteors occur in great numbers during August, aud are comparatively rare at the later period. The yellow appear in about average quantity in each month as compared with the whole year, but the red exceed the average somewhat in November. Hence it may be deduced, that at the autumnal period the meteorites generally burn with a red or orange glow, while those which cross our orbit about the 10th of August display in combustion a blue colour, and this is in perfect accordance with what is observed on a closer inspection of Prof. Powell's lists. The speaker stated that last August he had had the good fortune to witness tbese streaming blue meteors passing from east to west, and leaving a phosphorescent train in their wake.

Anotber fact of interest connected with this subject, is the change that is frequently remarked in the colour of a meteor during its passage. Thus the French observations make repeated mention of falling stars that changed from white when overhead, to bluish or reddish in the horizon; from white they bave been also seen to change to orauge-yellow and blue-green, to reddish and bluish with a reddish train; and from yellowish-white to orange-yellow and greenish-white, the meteor being broken into several fragments, two of which passed from white to the colour of red-hot iron. The changes from orange-yellow to green, and from yellow and red to greenish-yellow, have also been recorded hy M. Coulvier Gravier. The Chinese tell of the converse change from red to white, and British observations record the passage from blue to red; from blue to green, and finally red; from green to crimson; and from green to orange and red. The trains left by meteors during their flight are usually of the same colour as the meteors themselves, but not always so; thus red meteors have sometimes left a blue luminosity, and conversely red sparks have frequently fallen from meteors of another colour. The Chinese record such instances in such terms as "at the moment when the globe of fire fell, a flame appeared, and a score of little red stars jumped out of it."

On turning over the British Association Catalogues we observe many indications of these changes of colour; thus, in an account of a meteor seen at Poona on Sept. 7, 1847, we read—"Before the first bursting the meteor was of exceeding brightness, of an intense blue colour, and at the instant of explosion it changed into red." The following is nearer home. A fire-ball is thus described by an observer at Lambeth:—"As it brightened it displayed the most lovely colours, which could be distinctly traced to the radial colours produced by the sun; at one period green, violet (deep), pale red, &c., and their effects through the thin stratum of clouds which were in its path were most gorgeous." In a most graphic description, given by a lady, of a meteor that appeared over Hampstead, we find the remarkable statement:—"It shot forth several fiery coruscations, and while we were gazing at it broke into an *intensely* radiant cloud. . . . . It cast a most brilliant light on the houses there, brighter than moonlight, and unlike any light I ever saw. It appeared of a blue tint on the bricks, but there was no *blue* light in the cloud itself."

In discussing these reputed facts it is necessary to take into account certain illusions to which observers are subject. Thus, at the outset, there is the diversity of names given to the same colour by different persons. No two individuals, however perfect their perception of colour, would perhaps agree in their mode of naming the colours of all the stationary objects around them; how very likely, then, would they be to disagree in naming the colour of a light which appeared suddenly and unexpectedly in the sky, and as suddenly disappeared! Many instances of this discrepancy might be cited from the accounts of observed meteors; but the most curious instance with which the speaker was acquainted had occurred in the descriptions of the beautiful meteor that travelled over England on the 12th of last September, being visible in the evening before even tbe daylight had disappeared. Of the many eye-witnesses who described the pheuomenon in the *Times* newspaper, five mentioned its apparent colour; of whom F. A. B. states it to have been "green at first;" N. R. "greeu, surrounded by white;" W. Rowlett "white;" and W. "vivid, whitish blue;" while B. H. asserts that it was "primrose." Here, however, the discrepancy is so great as to lead us to the couviction that the meteor of September 12, 1858, was really one of those that change colour during their passage through our atmosphere, and thus present different appearances to observers in different places.

It is quite possible that a meteor may emit rays which in the aggregate would produce one colour, and yet may affect the observer with a sensation of a different colour. This may arise either from absorption, intensity, or contrast.

In illustration of the effect of absorption Dr. Gladstone exhibited the prismatic spectrum by means of the electric lamp, and showed how certain glasses produced a similar absorption of the rays to that which takes place in the common phenomena of the red sun, or orange moon. The effect of dispersion was rendered visible by the non-transmission of the extreme blue and violet rays through water into which a little milk had been poured. This "sky-blue" mixture, produced by a substance itself colourless, represeuted the light clouds and vapours which must frequently affect the apparent colour of meteors, and suggested a simple explanation of the fact that of the variable meteors observed in the misty skies of England, so many terminate in red. Smoke has much the same effect on the spectrum as milk and water.

In illustration of the effect of intensity in causing ligbts actually coloured to produce very nearly the sensation of white, the electric light, from charcoal points, was exhibited under red and blue glasses, when it appeared dazzling and almost white, though no white light was really transmitted, and such objects as common paper, when illuminated by it, reflected the coloured radiance. This will explain the phenomenon so frequently observed by M. Coulvier Gravier, of a white meteor becoming bluish or reddish as it approached the horizon; and also the paradox of an "*intensely* radiant cloud" white in itself, but throwing a *blue* light on the walls of houses. In these cases it seems highly probable that the incandescent meteors were really emitting coloured light, but that this colour did not become apparent till the light was reduced either by distance, or by reflection from other objects. In a similar manner, the fact of a yellowish meteor becoming more or less green as it passes away from the spectator, so frequently noticed in the French observations, may be explained by the well known changes in the chromatic impressions produced by yellow rays according to their intensity.

In reference to the effect of contrast it was remarked, that every lady is aware of the alteration that may be produced in the apparent tint of any article of dress by the juxtaposition of some other bright colour; and, indeed, it may be laid down as a general law that the apparent colour of every object is affected to a greater or less degree by the colours of all other objects seen at the same time. This remark holds good equally of self-luminous bodies, as, for instance, the flame of a gas-lamp, which assumes a rather bluish tint when the intensely yellow soda flame is brought beside it. This also must be a source of error in the observations of meteors.

After making due allowance for these points of difficulty and probable fallacy, we may approach the question—How far are these chromatic phenomena in accordance with the cosmical theory? Were pieces of iron to be shot through our atmosphere at the rate of twenty miles per second, there is good ground for believing that the friction would make them red-hot, if not incandescent. An iron wire, heated in the galvanic circuit, was observed by the speaker to emit at first principally orange and green rays, but as the heat increases the true red rays are emitted in an increasing degree, till "bright redness" is attained; and when combustion begins blue rays are also given forth, the general impression being then that of a reddish whiteness. The combustion and scintillation both of ordinary and of meteoric iron were shown in several ways. The metallic masses which fall through the air are never composed solely of iron, and it is difficult to say which metal or which other constituent would be the first ignited. Nickel in combustion displays a larger amount of green rays; sulphur, as is well known, burns with a blue, and phosphorus with a white, flame. Two pieces of iron pyrites, attached to the wires of a powerful galvanic battery, when brought momentarily into contact, were ignited with a very luminous flame, which exhibited the characters of both burning iron and sulphur; and on one occasion, when the experiment was tried, the lambent blue flame of the latter element was visible for some time after the circuit was completely broken, and the ferruginous scintillations had ceased. The other metals occasionally found in meteorites, such as cobalt, zinc, or lead, will of course burn with their distinct flames; and the silicates, though incapable of combining with oxygen, may give out an intense light when strongly heated. This was demonstrated by placing the fragment of the meteoric stone that fell at Triguerre in the oxy-hydrogen blowpipe, when it began to fuse, and became brilliantly incandescent. In all these observations on the colours displayed by them there is nothing antagonistic to the idea that these luminous meteors are produced, as some have certainly been, by the combustion of such solid masses of metal and stone as occasionally strike the earth; but we are not yet in a condition to deduce its composition from the colour of any particular meteor.

ON PHOSPHORESCENCE, FLUORESCENCE, &c.

Professor Faraday, D.C.L., F.R.S.

The Lord Wensleydale, Vice-President, in the Chair.

The agent understood by the word "light," presents phenomena so varied in kind, and is excited to sensible action by such different causes, acting apparently by methods differing greatly in their physical nature, that it excites the hopes of the philosopher much in relation to the connection which exists between all the physical forces, and the expectation that that connection may be greatly developed by its means. This consideration, with the great advance in the experimental part of the subject which has recently been made by E. Becquerel, were the determining causes of the production of this subject before the members of the Royal Institution on the present occasion.

The well-known effect of light in radiating from a centre, and rendering bodies visible which are not so of themselves, as long as the emission of rays was continual—the general nature of the undulatory view, and the fact that the mathematical theory of these assumed undulations was the same with that of the undulation of sound, and of any undulations occurring in elastic bodies, were referred to as a starting position. Limited to this effect of light it was observed that the illuminated body was luminous only whilst receiving the rays or undulations.

But superadded occasionally to this effect is one known as *phosphorescence*, which is especially evident when the sun is employed as the source of light. Thus, if a calcined oyster-shell, a piece of white paper, or even the hand, be exposed to the sun's rays and then instantly placed before the eyes in a perfectly dark room, they are seen to be visible *after* the light has ceased to fall on them. There is a further philosophical difference, which may be thus stated; if a piece of white oyster-shell be placed in the spectrum rays issuing from a prism, the parts will, as to illumination, appear red, or green, or blue, as they come under the red, green, or blue rays; whereas if the phosphorescent effect be observed—*i.e.*, that effect remaining after the illuminating rays are gone, the light will either be white, or of a tint not depending upon the colour of the ray producing it, but upon the nature of the substance itself, and the same for all the rays.

The ray which comes to the eye in an ordinary case of visibility, may be considered as that which, emanating from the luminous body, has impinged upon the substance seen, and has been deflected into a new course—namely, towards the eye; it may be considered as the same ray, both before and after it has met with the visible body. But the light of phosphorescence cannot be so considered, inasmuch as *time* is introduced; for the body is visible for a time sensibly after it has been illuminated, which time in some cases rises up to minutes, and perhaps hours. This condition connects these phosphorescent bodies with those which phosphoresce by heat, as apatite and fluor spar; for when these are made to glow intensely by a heat far below redness, it is evident that they have acquired a state which has enabled them for a time to become original sources of light, just as the other phosphorescent bodies have by exposure to light acquired a like state. And then, again, there is this further fact, that as the fluor spar which has been heated does not phosphoresce a second time when reheated, still it may be restored to its first state by passing the repeated discharge of the electric spark over it, as Pearsall has shown.

Then follows on (in the addition of effect to effect) the phenomena of *fluorescence*, and the fine contributions to our knowledge of this part of light by Stokes. If a fluorescent body, as uranium glass, or a solution of sulphate of quinine, or decoction of horse-chesnut bark are exposed to diffuse daylight, they are illuminated, not merely abundantly but peculiarly, for they appear to have a glow of their own; and this glow does not extend to all parts of the bodies, but is limited to the parts where the rays first enter the substances. Some feeble flames, as that of hydrogen, can produce this glow to a considerable degree. If a deep blue glass be held between the body and the rays of the sun, or of the electric lamp, it seems even to increase the effect: not that it does so in reality, but that it stops very many of the luminous rays, yet lets the rays producing this effect pass through. By using the solar or electric spectrum, we learn that the most effectual rays are in most cases not the luminous ones, but are in the dark part of the spectrum; and so the fluorescence appears to be a luminous condition of the substance, produced by dark rays which are stopped or consumed in the act of rendering the fluorescent body luminous; so they produce this effect only at the first or entry surface, the passing ray, though the light goes onward, being unable to produce the effect again; and this effect exists only whilst the competent ray is falling on to the body, for it disappears the instant the fluorescent substance is taken out of the light, or the light shut off from it.

When E. Becquerel attacked this subject he enlarged it in every direction.* First of all, he prepared most powerful phosphori; these being chiefly sulphurets of the alkaline earths, strontia, baryta, lime. By treatment and selection he obtained them so that they would emit a special colour; thus, seven different tubes might contain preparations which exposed to the sun, or diffused daylight, or the electric light, should yield the seven rays of the spectrum. The light emitted generally possessed a lower degree of refrangibility than the ray causing the phosphorescence; but in some instances he was able to raise the refrangible character of the ray emitted to that of the exciting ray. By taking a given preparation, and raising it to different temperatures, he caused it to give out different coloured rays by the single action of one common ray: this variation in power returning to a common degree as the temperatures of the phosphori became the same in all. He showed that *time* was occupied in the elevation of the phosphorescent state by the ray; and also that time was concerned in various degrees during the emission of the phosphorescent ray; that this time, which in many cases was long, might be affected, being shortened by the action of heat, and then the brilliancy of the phosphorescence for the shortened time was increased. He showed the special relation of the different phosphori to the different rays of the spectrum, pointing out where the maximum effect occurred; also that there were the equivalents of dark bands—*i.e.*, bands in the spectrum, where little or no phosphorescence was produced.

These phosphori were many of them highly fluorescent. Thus, if one of them was exposed to the strong voltaic light, and then placed in the dark, it was seen to be brilliantly luminous, gradually sinking in brightness, and ultimately fading away altogether; but if it were held in the rays beyond the violet end of the spectrum (the more luminous rays being shut off) it was again seen to be beautifully luminous, but that state disappeared the instant it was removed from the ray. Now this is fluorescence, and the same body seemed to be both phosphorescent and fluorescent. Considering this matter, and all the circumstances regarding time, Becquerel was led to believe that these two luminous conditions differed essentially only in the *time* during which

* *Annales de Chimie et de Physique*, 1859, tome lv., p. 1.

the state excited by the exposure to light continued; that a body being really phosphorescent, but whose state fell instantly, was fluorescent, giving out its light while the exciting ray continued to fall on it, and during that time only; and that a phosphorescent was only a more sluggish body which continued to shine after the exciting ray was withdrawn. To investigate this point he invented the *phosphoroscope;* an apparatus which may vary in its particular construction, but in which discs or other surfaces illuminated by the sun or an electric lamp, might, by revolution, be rapidly placed before the eye in a dark chamber, and so be regarded in the shortest possible space of time after their illumination. By such an apparatus Becquerel showed that all the fluorescent bodies were really phosphorescent; but that the emission of light endured only for a very short time.

An extensive series of experimental illustrations upon the foregoing points was made with fine specimens of phosphori, for which the speaker was indebted to M. Becquerel himself. The phosphoroscope employed consisted of a cylinder of wood, one inch in diameter and seven inches long, placed in the angle of a black box with the electric lamp inside, so that three-fourths of the cylinder were external, and in the dark chamber where the audience sat, and one-fourth was within the box, and in the full power of the voltaic light. By proper mechanical arrangements this cylinder could be revolved, and the part which was at one instant within, rapidly brought to the outside, and observed by the audience. As the cylinder could be made to revolve 300 times in a second, and as the twentieth part of a revolution was enough to bring a sufficient portion of the cylinder to the outside, it is evident that a phosphorescent effect which would last only the 1-3000th or even the 1-6000th of a second might be made apparent. All escape of light between the moving cylinder and the box was prevented by the use of properly attached black velvet.

The cylinder was first supplied with a surface of Becquerel's phosphori. The effect here was, that when by rotation the part illuminated was brought outside the box it was found phosphorescent. If the cylinder continued to rotate it appeared equally luminous all over, and when the rotation ceased, or the lamp was extinguished, the light gradually sank as the phosphorescence fell. Then a cylinder having a surface of quinine or æsculin was put into the apparatus. Whilst the cylinder was still it was dark outside; but when revolving with moderate velocity it became luminous outside, ceasing to be so the moment the revolution stopped. Here the fluorescence was evidently shown to occupy time; indeed, the full time of a revolution; and taking advantage of that, the self-shining of the body was separated from its illumination within, and the fluorescence made to assume the character of phosphorescence. Another cylinder was covered with crystals of nitrate of uranium, a hot saturated solution having been applied over it with a fine brush. The result was beautiful. A moderate degree of revolution brought no light out of the box; but with increased motion it began to appear at the edge. As the rapidity became greater, the light spread over the cylinder, but it could not be carried over the whole of its surface. It issued as a band of light where the moving cylinder left the edge of the box, diminishing in intensity as it went on, and looking like a bright flame, wrapping round half the cylinder. When the direction of revolution was reversed, this flame issued from the other side; and when the motion of the cylinder was stopped, all the phenomena of fluorescence or phosphorescence disappeared at once. The wonderfully rapid manner in which the nitrate of uranium received the action of the light within the box, and threw off its phosphorescence outside, was beautifully shown.

The electric light, even when the discharge is in rarefied media, or as a feeble brush, emits a great abundance of those rays, which produce the phenomena of fluorescence; but then if these rays have to pass through common glass they are cut off, being absorbed and destroyed even when they are not expended in producing fluorescence or phosphorescence. Arrangements can, however, be made in which the advantageous circumstances can be turned to good account with such bodies as Becquerel's phosphori or uranium glass. If these be enclosed within glass tubes, having platinum wires at the extremities, and which are also exhausted of air and hermetically sealed, then the discharges of a Ruhmkorff coil can be continually sent over the phosphori, and the effects both fluorescent and phosphorescent be beautifully shown. The first or immediate light of the body is often of one colour, whilst on the cessation of the discharge the second or deferred light is of another; and many variations of the effects can be produced.

In connection with rarefied media it may be remarked, that some of the tubes by Geissler and others have been observed to have their rarefied atmospheres phosphorescent, glowing with light for a moment or two after the discharge through them was suspended. Since then Becquerel has observed that oxygen is rendered phosphorescent—*i.e.*, that it presents a persistent effect of light, when electric discharges are passed through it. I have several times had occasion to observe that a flash of lightning, when seen as a linear discharge, left the luminous trace of its form on the clouds, enduring for a sensible time after the lightning was gone. I strictly verified this fact in June, 1857, recording it in the *Philosophical Magazine,** and referred it to the phosphorescence of the cloud. I have no doubt that that is the true explanation.

* *Philosophical Magazine,* June 1857, p. 506.

Other phenomena, having relation to fluorescence and phosphorescence, as the difference in the light of oxygen and hydrogen exploded in glass globes, or in the air, were referred to, with the expression of strong hopes that Becquerel's additions to that branch of science would greatly explain and extend them.

GUNNERY EXPERIMENTS.

Continued from p. 201.

EXPERIMENTS PERFORMED AT VINCENNES WITH A BREECH-LOADING GUN, MOUNTED ON A CARRIAGE OF PECULIAR CONSTRUCTION.

Invented by Lieut. ENGSTRÖM, Royal Swedish Navy.

Report made to the Minister, 27th September, 1857.

Twenty-four pounder gun, with smooth bore (*âme lisse*).

Weight of gun, 2,710 kilogrammes; carriage and appurtenances, 2,960 kilogrammes.

Distance of aim, 550 metres.

Charge, from 4 to 6 kilogrammes.

PART PERFORMED BY THE BARREL (*L'OBTURATEUR).*

It has been proved that the gun cannot be discharged unless the barrel (*l'obturateur*) be turned so as to allow of perfect correspondence between the two vents (*lumières*), which does not take place until the barrel (*l'obturateur*) has revolved 1-4th on itself.

In consequence, the adoption of a vent (*lumière*) composed of two levels (*portées*) presents great advantages.

It was recognised, by observation made of the gun at the moment of firing, that there was *no escape of gas* from the breech, but the fact has moreover been confirmed by direct experiments, for grains of gunpowder having been strewn in the interstices of the hinder rings (*anneaux posterieures*), it was observed that this powder did not ignite when the gun was fired. It has thus been proved that the elastic rundle (*la rondelle elastique*) *efficiently prevents the escape of gas from the breech.*

The barrel (*l'obturateur*) *of M. Engström performs its functions very well, it is worked with ease,* it possesses great solidity, and cannot be separated from the gun (*la pièce*), except by the rupture of the whole system.

MANNER OF USING THE LOADING-LADLE (*LANTERNE A CHARGER*).

In adopting a loading-ladle, M. Engström has supposed that the gun would be charged with a fourth of the weight of the ball, and without wad (*bouchon*). He places the charge of powder in a bag of serge, covers it over with tow, and then adds the ball; this being done he closes the bag, and the rather short cartridge can thus be contained in the ladle (*lanterne*). In conformity with the rules laid down during the experiments at Vincennes, the charge was one-third (*on a tiré au tiers*), the ball being placed between two wads.

Though recognising the utility of this apparatus, the Commission have been obliged to decline the adoption of it, except for some few trial shots; they affirm, however, that *the loading is effected with ease and security,* when first one wad is placed in advance of the ball, then the ball, and then a second wad and the powder-cartridge.

RAPIDITY OF DISCHARGE.

Twenty-one rounds were fired in ten minutes, with the successive charge (*chargement successif*) mentioned above, without there being any necessity for correcting the pointing (*repointage*). At the twelfth round the precision of the aim (*du tir*) was still satisfactory. After the twenty-first round the gun was somewhat heated, but the firing might have been continued without danger of accident.

Quick firing has likewise been tried, the ladle (*la lanterne*) being employed without wad. Twenty rounds were fired in nine minutes, with equal success. *The firing, when executed by three gunners* (*servants*), *may thus attain a rapidity of two rounds per minute.*

PRECISION OF AIM (*TIR*).

Notwithstanding that the displacement of the air (*le vent*) by the 24 lb. ball fired from M. Engström's gun is 4 millimetres, it was proved that the aim (*tir*) was very correct. *The mean deviations, even during the rapid firing without pointing* (*pointage*), *did not exceed* 0·5 *metres in every direction* (*dans tous les sens*).

CAUSE OF MISSING FIRE (*DES RATES*).

The cause of the gun missing fire might thus be in the direction of the vent, and may probably be avoided by using cartridges with truncated stems (*à culots troneoniques*), or else elongated and somewhat thinner cartridges.

POINTING (*POINTAGE*).

The experiments made relative to the rapidity of the discharge, prove that the pointing (*pointage*) is sufficiently secured for ten or twelve rounds.

STATE OF THE GUN AFTER FIRING.

On examination of the gun after two hundred rounds, it was found that only a slight settlement (*logement*) of the ball had taken place.

At first the bore (*l'obturateur*) was cleaned out with a wet sponge after each discharge, but it was proved *that no foulness ensued capable of injuring the play of the gun, and that these frequent cleanings were unnecessary;* nevertheless the cleaning was continued and the rundles of the barrel (*les rondelles de l'obturateur*) were slightly moistened after every round fired, because this precaution, so good in itself, causes no loss of time.

There is, therefore, reason to suppose that the vent of the gun is guaranteed by the rundles.

LIMIT OF THE ORDINARY EXPERIMENTS.

Three hundred and twelve rounds have been fired with a charge of one-third the weight of the ball (4 kilogrammes, and *twenty-seven* rounds into small charges—viz., *eighteen* with a charge of *three* kilogrammes, *four* with a charge of *two* kilogrammes, and *five* with a charge of *one* kilogramme) in order to ascertain the extent of the recoil and the reaction (*retour en batterie*).

ROUNDS WITH HEAVY CHARGES AND AT GREAT ANGLES.

Five rounds were fired with charges of *five* kilogrammes, and *five* with a charge of *six* kilogrammes, and afterwards *ten* rounds were fired at angles of elevation of 10°, and at angles of depression of 10°, with charges of *one* kilogramme and *four* kilogrammes. The results of these experiments were satisfactory.

RECOIL AND REACTION (*RETOUR EN BATTERIE*).

The gun recoils with *regularity*. When it has reached the farthest extent of the recoil, *it returns to its position* by the force of its own weight, having merely to surmount the resistance caused by the friction of the chase (*la volée*) and the cross bars (*entretoises*) on their respective supporters. The return into position takes place naturally *even when the shot is fired with a charge of no more than one kilogramme*.

In regard to this point, the system of M. Engström has performed its functions satisfactorily. The extent of the recoil is the same whether the slided (*chassis*) be dry or *wet*.

The length of the slide (*chassis*) is sufficient under all the conditions of the discharge.

The conclusions of the Commission may be summed up as follows:—

1st. The sort of moveable breech proposed by M. Engström offers every desirable guarantee as regards exactness of the closing apparatus (*l'exactitude de la fermeture*), the facility of working it, and the safety of the gunners (*servants*), *and may be adapted to all kinds of guns*.

The vent pierced in the elastic rundle does indeed deteriorate (*se dégrade*) rather quickly, but it is believed that it would be easy to remedy this defect.

2nd. M. Engström's gun carriage, though contrasting in point of eccentricity of form with those in general use, is of an ingenious and satisfactory construction. It offers *every facility for the working of the gun*, which requires only three runners (*servants*).

It is found fault with for being too heavy, but it might be rendered less ponderous without losing any of its advantages.

To recapitulate. The Commission of Vincennes is of opinion that this system of artillery deserves to be studied. They strongly recommend its being subjected to further trials, in order that its true merits may be thoroughly understood, and a clear judgment be come to regarding the ameliorations which might be introduced, more especially in the elastic rundle (*la rondelle élastique*).

The General commanding the Artillery of the First Military Division, *has approved* the conclusions of the Vincennes Commission.

RESULTS IN FRANCE.

The Commission constituted at Vincennes for the purpose of directing the experiments in connexion with M. Engström's system of artillery, has conformed to the rules laid down 31st March, 1857. The experiments seem to have been conducted with care, as the results arrived at have proved *that the moveable breech used by M. Engstrom is, of all the apparatus of the kind, the one which most satisfactorily fulfils all the divers conditions required of such apparatus, the Committee approving of the conclusions come to by the Vincennes Commission*, are of opinion that it will be right to continue the trials, with a view to its adoption practically.

The 24-lb. gun of M. Engström, which has been tried at Vincennes, has a smooth bore (*âme lisse*), but it is right to add that the system in question—*i.e.*, a moveable breech—may be adapted to rifled cannon (*canons rayés*), as has been done in England during trials carried on in the months of July an August.

(Signed) Vicomte de la Hitte, General of Division, Senator and President of the Artillery Committee.
Pelet, Colonel of Artillery, Secretary to the Committee.

Approved 3rd October, 1857.
(Signed) Vaillant, Marshal of France. Secretary of State for War.

These experiments were continued at Vincennes in 1858.

Six hundred and forty-four rounds have been fired in France with this 24-pounder gun (in addition to the trials in Sweden). The barrel (*l'obturateur*), made of wrought iron (*fer forgé*) was rendered unserviceable after 424 rounds, because of a flaw in the manufacture; and a similar one was made in cast iron (*fer de fonte*), with which 220 rounds were fired. After this number of rounds the gun was declared unfit for service, this result being attributed to the fact that divers essays were made with copper rundles, those of the inventor being of cast steel. It is acknowledged that the arrangements of the inventor were, upon the whole, the best.

Although these experiments were not so favourable as might have been desired, the inventor acknowledges and affirms *that the experiments were conducted with great talent and with the utmost impartiality, and that they may serve as a model for all experimenting commissions.*

The Vincennes Commission of 1858 give the following data:—

Since the commencement of the trials the gun was fired.

With the first barrel	424 rounds
With the second barrel	220 ,,
Total	644 rounds

After this an escape of gas took place, and considerable deteriorations were pointed out. These were more especially connected with the system of the moveable breech (*enlasse mobile*),* and caused the gun to become unfit for service. Stopping at this conclusion, one might be led to infer that the system of M. Engström, *though presenting the most complete means of closing* (*fermeture*) *known*, nevertheless, does not answer the object held in view, as it seems to involve a great wear and tear of the gun. *But the numerous essays* (*tâtonnements*) which have been made with a view to obviate the inconvenience of the too rapid increase of the vent in the rundle—the various positions given to these rundles for the purpose of introducing new vents; the fact of there being two vents open at one and the same time during the discharge; the unfortunate attempts with the copper rundles, which invariably worked badly, sufficiently explain this deterioration, which, besides, did not commence until the essays (*tatonnements*) were made, but which, having commenced, must of necessity go on increasing.

The only *very evident* fact that has resulted from the experiments which have taken place, is that from the moment that alterations were introduced in the rundles proposed by M. Engström, the results ceased to be satisfactory. Ought these rundles (*rondelles*) to be rejected on account of the wear of the vents after about 150 rounds? Such is not the opinion of the Commission. It would be sufficient to attach to (*d'affecter à*) each barrel (*obturateur*) one or two sets of extra rundles (*un ou deu jeux de rondelles de rechange*).

With the addition of the second vent, which it would be easy to introduce into each, a system would be attained which would last out any gun. If, therefore, the bore (*l'obturateur proprement dit*) resists deterioration, the *question will in a great measure be solved*.

Now, the new barrel of cast steel (*acier fondu*) did not, after 220 rounds, give evidence of the deteriorations remarked in the first.

CONCLUSIONS.

To sum up, considering the real advantages which result from the proposed system, the Commission request that the trial may be continued in the following manner:—

Two new guns to be placed at the disposal of the Commission.

With one of these provided with a barrel (*obturateur*) of cast steel (*acier fondu*), and furnished with, say three steel rundles, the resistance of the bore (*obturateur proprement dit*) shall be determined.

This fact being ascertained, if it be deemed necessary, trials may be continued with other systems of rundles (*rondelles*). Finally, the experiments may be repeated with a gun in which the vent shall terminate in advance of the rundles (*aboutira en avant des rondelles*).

The command of these two guns will besides enable the Commission to make such experiments as the results of the new trials may suggest.

OBSERVATIONS RELATIVE TO THE CARRIAOE.

All parts of the carriage have resisted deterioration up to the conclusion of the trials.

Vincennes, 16th *September*, 1858.

[Here follow the signatures of the Members of the Commission.]

OPINIONS OF THE GENERAL.

Upon the whole there is reason to believe that a gun constructed on this system, with a barrel of cast steel, *would possess good elements of endurance* if it were furnished with two or three sets of rundles (*jeux de rondelles*), *similar to those which were first tried*. It is therefore desirable that the trials should be continued and conducted in accordance with the opinions expressed by the Commission.

The General Commanding the Artillery.

Vincennes, 25*th Septǝmber*, 1858.

The inventor has proposed that the gun should be repaired, as he is of opinion that it may still serve a long time for new experiments.

(Signed) C. C. Engström,
Lieutenant Royal Swedish Navy.

Stockholm, 8*th April*, 1859.

INSTITUTION OF CIVIL ENGINEERS.

PREMIUMS—SESSION 1858-59.

The Council of the Institution of Civil Engineers have awarded the following premiums for Papers read during the Session recently concluded:—

1. A Telford Medal to Michael Scott, M. Inst. C.E., for his Paper, "Description of a Breakwater at the Port of Blyth, and of Improvements in Breakwaters, applicable to Harbours of Refuge."

2. A Telford Medal to Robert Mallet, M. Inst. C.E., for his Paper "On the Coefficients of Elasticity and of Rupture in Wrought Iron, in relation to the volume of the Metallic Mass, its metallurgic treatment, and the axial direction of its constituent crystals."

3. A Telford Medal to Henry Bessemer, for his Paper "On the Manufacture of Malleable Iron and Steel."

4. A Telford Medal and the Manby Premium, in Books, to William Joseph Kingsbury, Assoc. Inst. C.E., for his Paper, "Description of the Entrance, Entrance Lock, and Jetty Walls of the Victoria (London) Docks; with Remarks on the Form adopted in the construction of the Wrought Iron Gates and Caisson."

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* The translation is given according to what I think has been meant; but the passage is obscure, and probably some mistake has been made in transcribing.—[Ed.]

5. A Watt Medal to James Wardrop Jameson, Assoc. Inst. C.E., for his Paper "On the Performances of the Screw Steam-ship *Sahel*, fitted with Du Trembley's Combined Vapour Engine, and of the Sister Ship *Oasis*, with Steam Engines worked expansively, and provided with partial surface condensation."

6. A Council Premium of Books to Thomas Sebastian Isaac, for his Paper "On the Successful Working, hy Locomotive Power, over gradients of 1 in 17, and curves of 300 ft. radius ou Inclines in America."

7. A Council Premium of Books to Matthew Bullock Jackson, M. Inst. C.E., for his Paper, "Description of the Gravitation Waterworks at Melbourne, South Australia."

MINING MACHINERY.

(Continued from page 176.)*

It will be observed that all this time no such thing as a pump, either upon the common or the plunger principle, was even thought of. The fact appears to be that no man in the north of England or in Scotland was at that time capable of constructing a common pump. This circumstance may be gathered distinctly from the records of the family of Mar. In 1709 the Earl of Mar sent his colliery manager to Newcastle, which was then, as now, regarded as a sort of head school of mining. From the manager's report, it appears that the machines in use were, as already stated, water-wheels and horse-engines, with chain pumps for raising water and horse-gins for raising coals; the common depth of the pits being from 120 to 180 ft., and a few from 300 to 350 ft. The steam-engine is not even alluded to. The Earl called in the aid of George Sorocould, an engineer from Derby, to assist and advise his plans. Sorocould recommended substituting pumps in place of chains and buckets. But when he went away, no man could be found who was able to put his plans into execution. The millwright of Montrose, John Young, who had been in Holland, was referred to as capable of giving advice; and after him "the mechanical priest of Lancashire." It would seem that the recommendation of these almost forgotten worthies produced its effect; for the chain and bucket engine was superseded by the water-wheel, with crauks and beam-working pumps.

For raising coals the horse-gin was employed; the cog and rung showiug, in the old sketch, Fig 3,† was made use of at this period, as well as the common whim-gin, and was worked with 4 in. ropes and tubs. For a pit of 300 ft. depth, eight horses were required, two at a time, and a spare shrift of two horses; the coal was drawn in corves made of hazel rods with wooden bows, each corve carrying 14 to 15 coal-pecks, equal to 4 cwt. of coal, and a day's work was 21 score, or 420 corve loads; the weight raised from a pit was, therefore, 84 tons per day, being 10½ tons for each horse. At the present time it is not uncommon to raise 400 to 500 tons per day from a single pit of three times the above depth; this quantity being raised in deep pits exceeding 900 ft. depth by winding-engines of from 80 to 120 h.p. The pits were numerous —a part of the system being in fact to have them so. It was cheaper to sink a new pit, of the then moderate depths, than to convey, or rather drag, the coals a distance underground; and it became a kind of rule for this reason, and also on account of ventilation, that the pits should not be more thau 500 to 600 ft. from one another. This explains the occurrence of the great number of old shafts which are found where coal beds have been worked near the surface.

On comparing the mining practice above described with that pnrsued in Germany at the same, and even a much earlier, period, it will be found that, until the epoch of the steam-engine, the English system was by no means greatly advanced. It appears from Agricola's curious work, written in 1550, that at that period the applications of machinery in the German mines were both numerous and complicated. They had not only the common horse-gin, but several applications of the water-wheel, both for raising the produce of the mine, aud for lifting the water, as well by means of the common pump as by chain pumps aud rag wheel work; they employed also the water-wheel with double huckets arranged in reverse order, for the purpose of more conveniently changing its motion—a method not brought into use in the Newcastle coal-field until about two centuries afterwards. For ventilation they employed bellows with attached air tubes, and a variety of applications resembling in principle the fanner of the winnowing machines—instruments which are still in use for common purposes. They had also carriages with wheels underground—a notable feature of superiority over the sledges made use of in our coal mines. Their methods of conveyance at the surface were, however, unimproved; besides common wains, they continued to use sledges for this purpose; the ore was also carried on the backs of horses, of men, and even of dogs. However, the pumping machinery described by Agricola as consisting of water-wheels, and cranks, and beams continues to this day to be the simplest and one of the cheapest modes of draining mines, where sufficient water-power can be obtained. The crank and fly-wheel are also old appliances, which appear again and again in Agricola's diagrams. Fig. 4 is an old sketch, showing pumps worked by a water-wheel with cranks. The fly-wheel was commonly applied at that time, as it has been since, to the common windlass or jack-roll. "The roll being once put in motion," says he, "is much helped, and rendered more easy to be turned by the revolutions of the fly-wheel." He appreciates accurately the nature of the fly-wheel as an equaliser of force, assisting the motive power at those points of tbe revolution where it becomes weakest; and this notion of its use is clearly indicated in his expression that "it was employed instead of another man."

The use of gunpower for blasting rocks had not yet become common in Englaud, though it had been employed for this purpose in Germany about the year 1665. The process made use of for mining very hard rocks before the introduction of gunpowder was that of either splitting them by fires of wood or charcoal, or rending them by an apparatus called the "stook and feathers;" a hole was drilled in the rock, and the feathers, which were two thin plates of iron thickening towards the lower extremity, were placed in it; a wedge was then driven home between them, until a fragment of the rock was torn off by its action.

During the seventeenth century, and for a long time afterwards, many ingenious shifts were adopted underground to obtain coal lying below the common level of drainage; rifts were formed in the coal, and cuts made to the lower parts, from which the water was lifted up to the requisite level by baling it with wooden scoops or by such machines as were then used underground; the principal of these was the rag-pump, shown in the old sketch, Fig. 5, worked by hand, having a wooden pump-tree, with endless chaiu and leatbers, and lifting the water in stages, each generally from 8 to 12 ft. lift. In this manner the miners sometimes succeeded in penetrating step by step a considerable way to the deep, so that more modern workings have often suddeuly holed into these old mine wastes, in situations where much solid coal was expected to intervene, but where it had already beeu excavated by the iudustry of the "old man;" and these old workings, of which no plans or records are preserved, being filled with water, a great deal of damage as well as loss of life has from time to time resulted from the inundations which ensued from holing into them.

It thus appears that the principal machinery employed iu winning and working collieries at the beginning of the last century, consisted of the chain and rag pumps for liftiug water, the moving powers being horses, water, and wind; and the horse-gin for raising the coal.

To this middle period of mining helongs also the introduction of railways. Coals were previously carried from the pits to the river by carts or wains, which held about 8 coal bolls or 20 cwt. each, being rather more than the third part of a Newcastle chaldron of 53 cwt.; and the collieries of Kenton, Benwell, and Jesmond, near Newcastle, employed hetween 400 and 500 carts each in this expensive mode of conveyance. The earliest railways seem to have been constructed with a limited and definite object in view, that of increasing the load dragged by a horse; and, accordingly, the first coal waggons on the railway carried 42 cwt. of coals, a material improvement, at all events, upon the old coal wain; but still the leading establishments were large, as each single waggon required a man and a horse, and for a long period the gradients were laid out with reference only to this state of circumstances. The railways were constructed of wood; the upper rail generally of beech, 4 in. square, resting upon longitudinal sleepers, these again resting upon cross sleepers. The cost of construction was from £400 to £600 per mile, which, however, represented a much higher value at that time thau at present, as may be judged of from the fact that a collier's wages were 1s. per day, while the overman had 8s. per week, and the viewer 15s per week. The coal waggons resembled the modern chaldron coal waggon in shape, aud were made of wood, the employment of which was then in fact a necessity; for the quantity of iron made iu the kingdom did not for a long period after the introduction of railways amount to 20,000 tons yearly, though now the annual quantity manufactured is nearly 4 millious of tons. To the scarcity of iron must also be ascribed its very slow substitution for wood in railways. The application of the cast iron fish-bellied rail, and subsequently the malleable iron bar, were the work of a centnry and a half, during which the use of coke in place of charcoal for smelting gave so extraordinary a stimulus to the iron manufacture. So little was the possibility of applying coal or coke to the smelting of iron anticipated in early times, that there are upon record grauts of wood to be made into charcoal for the purpose of smelting iron, in the districts of Stanley Burn and Crawcrook, which are situated upon the Newcastle coalfield. It now appears not a little strange to find wood growing upon a coalfield thus appropriated for making iron; but even the name of collier, now applied to a coal worker, meant originally a charcoal burner, and is so employed in the grants above referred to.

Third Period of Coal Mining.—The commencement of the third period of coal mining in the early part of the eighteenth century is marked by the notable epoch of the introduction of the steam-engine. The importance of the Northumberland and Durham coal trade at this period, may be judged of from the fact that the annual shipments of coal from Newcastle averaged 475,000 tons, and from Sunderland 175,000, the aggregate being 650,000 tons; employing 600 ships, of about 80 Newcastle chaldrons each, and 4,500 seamen and hoys. Under these circumstances, it is not surprising that the beds near the surface and above the natural drainage levels were being fast exhausted.

The earliest applications of the steam-engine were directed solely to the

* From the Proceedings of the Institution of Mechanical Engineers.

† The Illustrations will appear in The Artizan for October.—[Ed.]

drainage of mines; and during the first forty or fifty years after its invention, it does not appear to have been thought of for any other purpose. Savery called his little publication, in 1699, on this subject, the "Miner's Friend;" but Newcomen and Crawley, in 1710, were the first who rendered the engine suitable for practical application. In 1713, an engine was constructed at Byker, near Newcastle; and at very nearly the same time two others were erected in that neighbourhood, one at Washington Fell, and the other at Norwood. The engines were at that time worked by attendants, who opened and shut the valves, until Beighton, of Newcastle, in 1718, introduced a great improvement, by which they were rendered self-acting. Stewart observes that, in 1714, only four steam-engines were in existence, two of which were upon mines in Newcastle. A few years after this date an engine was constructed by John Potter, of Chester-le-Street, in Durham, for draining Edmonston Colliery, the particulars of which have been preserved: the cylinder was 29 in. in diameter and made of brass, as also were the buckets and clacks and one of the working barrels; the pumps, 9 in. in diameter, were made of elm hooped with iron; the boiler top was of lead. The introduction of the steam-engine, imperfect as it still was, not only enabled deeper mines to be won, but also cheapened the cost of drawing water as compared with that by horses, in the ratio of about 7 to 1. The pumps, at first of wood, were afterwards made of cast iron.

Long after the introduction of the double-acting engine, the work was distributed over the up and down stroke by means of a dead weight acting on a separate balance beam; and this old custom is still adhered to in some parts of the Newcastle district. A step in advance was the application of the **V** bob, as shown in Fig. 6, consisting of a **V** shaped radius link, A, vibrating on a centre, fixed at a short depth down the pit, by means of which the beam was made to lift from both ends, with corresponding sets of pumps in the pit; some of the older engines are still worked in this manner. Fig. 6 is a diagram showing the application of the **V** bob at Backworth Colliery, near Newcastle. In a third improvement this oblique mode of applying the power was replaced by a direct lift from each end of the beam, a separate pit or staple, B, being sunk for the purpose, as shown in Fig. 9, which represents the general pumping arrangements at the Hester Pit, Hartley Colliery, near Newcastle. In this case the depth of the pit is 600 ft., the engine of 300 h.p., and the pumps 31 in. in diameter, made of wrought iron: the total cost of the engine and engine-house was £12,750. The quantity of water raised is 750 gallons per minute, making 382,395,200 gallons or 1,707,120 tons in a year; the total working expenses, including 8,960 tons of coal consumed, are £1,575 per annum, exclusive of interest of capital: hence the cost of raising the water from a depth of 600 ft. is 0·22d. per ton of water raised. In two other cases it is found that the cost is respectively 0·27d. and 0·21d. per ton of water raised 600 ft. The average is, therefore, 0·23d. per ton of water for 600 ft. depth, which may be taken as the mean cost of pumping water in Durham and Northumberland, exclusive of interest and redemption of capital. Under the old system, as already stated, a horse could raise 10½ tons per day from a depth of 300 ft.; and reckoning 4s. 6d. per day for the horse, driver, wear and tear of ropes, &c., this gives 5·14d. per ton raised 300 ft., or 10·28d. per ton raised 600 ft.; while from the same depth the same weight is raised by the steam-engine for 0·23d. Hence the cost is 45 times more by horses than by the steam-engine: besides which the increased depth at which modern mines are worked render them absolutely inaccessible by horse-power.

Attempts are being made to dispense with the cumbrous weight of beams, by placing the pumping-engine vertically over the mouth of the pit, the pump-rod being worked direct by the steam-cylinder. A diagram of this arrangement is given in Fig. 7, showing the direct-acting pumping-engine at Burradon Colliery, near Newcastle. There are here two cylinders of 60 in. diameter, and 6 ft. stroke, having their piston-rods connected at top by a crosshead, to the centre of which the pump-rod is attached, passing down between the cylinders. The pump-rod is made continuous throughout the entire series of pumps, passing through a stuffing-box at the bottom of each working barrel, as shown in Fig. 8; there is thus only a single pump-rod for the whole depth, instead of a separate rod for each set of pumps, as required in the ordinary arrangement, thereby greatly reducing the dead load upon the engine. The water is raised from a depth of 900 ft.; and the total cost of the engine, pumps, and building was only £4,600.

Pumping by a rotary motion is now much practised, especially in sinking pits; the crank engine being handier for application, while its greater number of strokes per minute has the effect of keeping the water better and more uniformly out of the bottom. Fig. 10 is a diagram showing the application of this method at Ryope sinking, near Sunderland.

But though the great mining problem was solved by the application of the steam-engine in the early part of the last century for raising water from mines, the miner having been enabled by its means to win the deeper coal of the field, thus acquiring an entirely new mining territory, still many years elapsed before steam power was applied directly for raising coals; and in the meantime various mechanical means were employed for this purpose. The old horse-gin continued in use, and commonly required 24 horses in a day, working four at a time; it was employed at Walker Colliery, near Newcastle, for a pit 600 ft. deep. But it was evident that some substitute must be found for animal power at such great depths. Various applications of machinery were therefore devised, amongst which may be mentioned one by Mr. Menzies, consisting of a descending vessel containing water which overbalanced and brought to the surface a basket of coals; the water was then discharged at the bottom, and if there was not a day-level it had to be pumped up again by the steam-engine. Notwithstanding this disadvantage, the plan was a simple and effective one, and continues in a modified form to be employed to this day in other districts, though not on the Newcastle coalfield, especially where the water can be got rid of by day-levels. Figs. 11 and 12 are an elevation and plan of a water-balance machine now working at the Cwm Bargoed pit, Dowlais Iron Works, South Wales. The coal tram, containing about 1 ton of coal, is placed upon the top of the empty water bucket A at the bottom of the pit, and the empty tram on the bucket B at the top; this bucket upon being filled with water descends, raising the empty bucket A with the full coal tram. The water is supplied through the valve-box C and air vessel by the Cornish pumping engine used for draining the mine. The landing chain D is a flat three-link chain, working over a turned pulley, E; the motion is controlled by a powerful break, F, and the buckets are guided by ¾ in. long-link chains, G. A single-link counterbalance chain, H, of the same weight per foot as the landing chain, D, is attached to the bottom of each bucket and hangs loose in the pit, for the purpose of balancing the landing chain. The pit is an upcast shaft, of about 600 ft. depth; and the quantity of coal raised is from 250 to 300 tons per day of 12 hours. These water-balance machines are extensively used in the Welsh ironworks, generally upon mines having free drainage, where they are a cheap means of raising materials. The cost of erection is small; and a breaksman is not required, as one of the landers at the top of the pit works the break. Even where the water for working the balance machine has to be pumped up by the engine, as in the above case, it is a cheap arrangement for moderate depths, when the quantity of material to be raised is moderate, say under 300 tons a day. The time occupied in filling the buckets limits the amount of work; and 300 tons a day may be taken as the maximum quantity that can be raised with safety by such a machine from a depth of 600 ft. The indirectness of application of the power is more than compensated for by the superior economy in the employment of steam in the Cornish pumping-engine as compared with the ordinary high-pressure winding-engine.

During the latter half of the last century water wheels were very generally used in raising coals: these were either single wheels, or with a double row of buckets set in reverse order, which enabled the motion to be reversed more expeditiously. Where water was not to be had at the surface, the steam pumping engine was made to pump the water which drove the water-wheel; and an extra power was thus expended in lifting the water, equal to that required for raising the coals from the bottom of the shaft. The double-water wheel erected at Walker Colliery, near Newcastle, by Smeaton, in 1778, shown in Figs. 13 and 14, drew 30 corves, each containing 6 cwts. of coal, from a depth of 600 ft. in an hour, being at the rate of 100 tons per day of 12 hours. In this apparatus a Newcomen engine was employed to pump water into a tank, A, from which it was discharged on to the wheel, B, by one of the two spouts, CC, alternately, the wheel having two sets of buckets set in opposite directions for giving a reversed motion; and the lander readily started and reversed the winding by pulling the cords, D, at the pit mouth, or stopped the wheel by the cord, E, putting on the break, F. As late as the year 1797 there were still numerous water wheels, with rope rolls on the same axle, at work in the coal districts of Northumberland and Durham.

The application of the steam-engine directly to winding is of recent date. The introduction of the steam winding-engine has been the cause of material changes in the underground arrangements; for, by enabling much larger quantities to be drawn daily from a single pit, the necessity for sinking other pits is obviated; and this, again, has occasioned great improvements in the underground modes of conveyance with a view to increased facilities of transit. With fewer pits better roads are required, and also better ventilation; so certainly does one step in advance lead to others. With the large winding-engines now used in the north of England, which are often of as much as 100 to 120 h.p., working upon a first motion, the average performance may be stated at 400 tons raised in 12 hours from a depth of 900 ft.; this includes the time occupied in drawing the workmen. The average winding speed in the shaft is from 15 to 20 ft. per second or 10 to 13 miles per day. In some cases, but not universally, a heavy counterbalance chain is wound round a continuation of the axle of the fly-wheel, for the purpose of balancing the weight of the long length of rope and tubs full of coal, when in the act of being lifted from the bottom of the pit, against the short length of rope and empty tubs at the surface: the chain works either into a staple (or small pit) sunk for the purpose, or upon an inclined plane.

The double-cylinder winding-engine is being introduced with success. Fig. 15, Plate 6, is an elevation of the double-cylinder horizontal winding-engine now working at Burradon Colliery near Newcastle. In this case the fly-wheel and counterbalance chain are dispensed with, and the engine works the rope rolls direct by a first motion. The two cylinders are 26 in. diameter and 5 ft. 6 in. stroke, coupled to cranks at right angles on the shaft of the rope rolls, which are 15 ft. 6 in. diameter, working with a flat wire rope ⅝ in. thick and weighing about 16 lbs. per fathom, or 2⅔ lbs. per foot. The pit being 900 ft. deep, about 18 revolutions are required in winding; so that the diameter of the drum is increased from 15½ to 17½ ft. Each load consists of 25 cwts. of coal, and the time of drawing is just 30 seconds, making the average winding speed 30 ft. per second, or 20 miles per hour. The time occupied in drawing and changing the tubs is as nearly as possible 1 minute; and the actual winding power is therefore 75 tons of coals per hour from a depth of 900 ft. The engine is worked with high pressure steam of 35 lbs. per sq. in.

The average cost of raising coals by winding-engines, for raising a quantity of 400 tons per day, including maintenance of the wire ropes, coals for the engine, repairs of engine and boilers, and men's wages, is—

0·70d. per ton for	300 feet depth.	
1·07	600	„
1·43	900	„
2·02	1200	„

The average cost of maintaining the pair of wire ropes is £1 per year for each fathom of depth, or 3s. 8d. per foot per year.

The principle on which the fly-wheel and counterbalance chain are dispensed within the double-cylinder engine is the same as that of employing two men or rather two half men instead of one in the original windlass: so long are principles, assumed three centuries ago, neglected before they are brought into practical operation. It is obvious that the double-cylinder engine with cranks at right angles to each other renders a counterbalance unnecessary, by enabling the power of the engine to follow the crank throughout the entire revolution; and for the same reason the fly-wheel as an equaliser of the power is dispensed with.

After the introduction of the steam-engine and its application to mining purposes as a means of drainage, the motive power of horses on railways was succeeded by that of fixed steam-engines with ropes, and self-acting planes, methods which continue in use; but even so early as 1813 a locomotive engine was employed for leading coals along the Wylam Colliery Railway. The Newcastle Coal Field was also the earliest scene of the genius of George Stephenson, whose first locomotives were constructed, in 1814, for the conveyance of coals along the Killingworth Colliery Railway, and with the Wylam engine may be regarded as constituting the commencement of that modern railway system which has been developed in so extraordinary and rapid a manner.

A circumstance which appears anomalous is the very late introduction of railways underground, which did not take place in England until about sixty years ago, a century after their employment on the surface. But this may be, to a great extent, accounted for by what has been already noticed respecting the sinking of pits; so long as they were sunk tolerably close together, the necessity for improved means of underground transit was not felt, but after deeper pits had been sunk, and the distance of the working from the shaft became consequently greater, the system of sledging, carried out first by manual labour and then by horses, gradually yielded to an imitation on a smaller scale of the wooden railways employed above ground, which enabled a horse to drag two or three of the basket corves instead of one only. By slow degrees cast iron, and ultimately malleable iron, rails were introduced; and as the last improvement, the carriages conveying the coals were brought from the face of the workings to the surface "on their own foot"—that is, without changing the mode of transit.

Horses and ponies are chiefly employed for the purpose of underground conveyance, and minute calculations have been made of the expense of this mode of conveyance. On a descending gradient of 1 in 144, the rails weighing 22lbs. per yard, and the tubs carrying from 7 to 10 cwts. of coal each, a horse brings out 34 tons of coals per mile per day at a cost of 3·1d. per ton per mile, including haulage, maintenance of carriages and way, but not interest on capital of construction. The gross weight of a train in this case was $6\frac{1}{2}$ tons, the weight of coals being 4 tons and the weight of the carriages $2\frac{1}{2}$ tons. On the contrary, with an ascending gradient, now rarely tolerated, the expense has been known to amount to 8d. per ton per mile. In either case the use of underground railways is a great improvement upon the previous sledge system, under which a horse's performance was not more than one-tenth of its present amount. But a cheaper mode of underground conveyance is still wanted, the cost being on the average three or four times as much as that by railways on the surface. In cases where coals are to be brought from distant workings, a steam-engine placed at the bottom of the pit is sometimes employed; with an endless wire rope where the way is level, or double ropes where the gradient is sufficient to enable the empty train to overhaul the rope; and in this case the cost has been brought as low as 2d. per ton per mile. The self-acting inclined plane, first introduced by Mr. Barnes, at Benwell Colliery, near Newcastle, in 1797, is also employed underground, an application for which it is peculiarly suited, owing to the naturally inclined position of the strata.

With regard to the ventilation of mines, the agent employed for this important purpose in the Northumberland and Durham district is a rarefied column of air, heated by an underground furnace, or in a few cases by a furnace and chimney at the surface. The mechanical conditions established by the rarefraction can readily be calculated, as they depend upon the mean temperature and corresponding weight of the expanded or upcast column of air, compared with the weight of the cold or downcast column of air of the same length; the motive or ventilating power is thus easily ascertained. In the case of Haswell Colliery, near Newcastle, for example, the observed mean temperature of the upcast shaft is 163° Fahr.; and that of the downcast may be taken at 50°. The depth of the upcast shaft is 636 ft.; and the weight of the upcast column of air of this length at 163° is the same as that of a column of 766 ft. length of air at 50°: the expansion of air for each degree Fahr. being $\frac{1}{491}$th of its volume at 32°, or $\frac{1}{509}$th of its volume at 50°. Hence the column of air in the upcast shaft would stand if cold at a height of only 766 ft.; and therefore the effect of the furnace is to lift the air through the further height of 170 ft., and this work is done upon the whole of the air passing up the shaft from the mine. The observed quantity of air passing through the mine is 94,960 cubic ft. per minute of air at 50°, or 7,407 lbs. per minute, the weight of 1 cubic foot of air at 50° being 0·078 lb. Therefore the useful h.p. developed by the furnace is 7,407 lbs. lifted 170 ft. in 1 minute, or 1,259,190 lbs. lifted 1 foot in 1 minute, which divided by 33,000 gives 38 h.p. as the ventilating power of the furnace. The coal consumed in the furnace is 8 lbs. per minute; hence the duty performed is 17,628,660 lbs. raised 1 foot high by 1 cwt. of coal. This is therefore the actual result obtained with the ventilating furnace at Haswell Colliery. At Seghill Colliery, near Newcastle, the duty is only 5,573,333 lbs. raised 1 foot high by 1 cwt. of coal: the quantity of air passing through the mine is 42,700 cubic ft. per minute.

In both the above examples the rate of duty obtained with the ventilating furnace is low: and it may indeed be regarded as a remarkable circumstance that purely mechanical appliances have been so little used for ventilating mines. The writer is not aware of a single example of ventilation by mechanical means in the two great coal mining counties of Durham and Northumberland. Elsewhere mechanical appliances are in use for ventilating mines, and amongst them may be mentioned Struvé's mine ventilator, several of which are employed in the South Wales colliery district, at Eaglesbush, Duffryn, Risca, and other collieries. This ventilator is illustrated in the accompanying Plates: Fig. 16 is a sectional elevation, and Fig. 17 a plan; Figs. 18 and 19, are vertical sections. The air is drawn from the mine by means of a pair of large aerometers, A A, made of boiler plate and similar in construction to ordinary gasholders, each working up and down in a circular chamber of brickwork, B, the bottom edge of the aerometer being immersed in an annular trough of water, C, in the walls of the chamber. At the top and bottom of each chamber are two sets of air valves, I and O, consisting of simple wooden flaps hung upon vertical gratings, which open inwards on the side I, communicating with the pit, and outwards on the opposite side, O. In the up-stroke of the aerometer the air from the pit, D, is drawn in along the passage, E, and enters below the aerometer through the bottom inlet valves, I, while that above the aerometer is expelled through the top outlet valves, O; in the down-stroke, the air below the aerometer is expelled through the bottom outlet valves, O; while more air from the pit is drawn in above the aerometer through the top inlet valves, I. The two aerometers are worked by cranks at right angles to each other, thus rendering the draught of air from the pit practically uniform.

Up to the present period the various machines employed for ventilating have not supplied the same quantity of air as is obtained by the underground furnace in well laid out coal mines, where the air channels are maintained in proper condition, and are of an area in no case less than 40 sq. ft. However satisfactorily, therefore, some of these machines considered separately may have worked, they do not at present offer sufficient reasons for superseding generally the furnace ventilation. They are also liable to derangement, an important feature not applicable to the furnace; for even if the fire be extinguished the heat of the upcast shaft is still sufficient to cause the circulation of a free air current for a period of some days. The simplicity of its construction is also a great argument in favour of the furnace, which thus continues, with all its inconveniences, to be the principal ventilating agent for mines.

The labours of the Mining Institute of Newcastle may be expected to conduce to the improvement of the ventilation as well as of the drainage and working of mines; and may probably be the means also of developing principles, the importance of which cannot at present be appreciated, whether as regards economy of production or security against those terrible explosions of fire-damp which continue to be the bane and reproach of modern mining.

Before the introduction of the safety-lamp, mines liable to issues of fire damp were lighted by the steel-mill; by means of toothed wheels a rapid revolution was given to the steeled rim of a wheel, against which a piece of flint was at the same time held, and the stream of sparks produced was sufficient to give at least a feeble degree of illumination. The principle of this mode of lighting depends upon the circumstance that fire-damp or light carburetted hydrogen requires the contact of flame for its ignition, and is not fired by merely incandescent substances or by very small points of flame. In this respect it differs from either hydrogen gas or the other compounds of carbon and hydrogen.

It has thus been endeavoured to trace the mechanical appliances of coal mining from the earliest periods down to the present time. At first, it has been seen, the beds of coal lying close to the surface were worked by the simplest mechanical means; while in the gradual progress onward there is a corresponding improvement of machinery, resulting at last in the application of the most powerful agencies now in use. From the original jack-roll, adit, and pack horse, to the steam-engine and the railway, the progress is not a little curious. The coal mines of Northumberland and Durham, which had so small a beginning, are now, according to an estimate based upon returns made to the coal trade office, drained and worked by 443 steam-engines, representing 26,740 commercial h.p. The production last year was nearly 16 million tons of coal, being one quarter of the total produce of coal raised in Great Britain. If in the absence of accurate statistics a similar scale be assumed for general application, it will be found that the total coal production of Great Britain employs nearly 2,000 steam-engines, of an aggregate of 120,000 commercial h.p., but representing the actual work of about 300,000 horses; a singular contrast with the still recent period when two solitary pumping engines lifted the water from mines on the bank of the Tyne.

REVIEWS AND NOTICES OF NEW BOOKS.

Rifled Ordnance. By Lynall Thomas, F.R.S.L. Fourth Edition, revised and enlarged. London: J. Weale, 1859.

This work, which professes to be a practical treatise on the application of the principle of rifling to guns and mortars of every calibre, is dedicated to his Royal Highness the Duke of Cambridge, K.G., &c., and deserves the attention of all interested in the improvement of ordnance, for although the author entertains peculiar views of his own, and appears in the character of an inventor, his work is evidently the result of considerable study and research, and forms an admirable digest of the best practical works upon gunnery and the allied subjects; a list of the works consulted by him being given by the author. In addition to the numerous excellent chapters devoted to the consideration of ordnance and the projectiles used and to be used therewith, the author republishes a very interesting paper on the nature of the action of fired gunpowder which was read before the Royal Society in December last. This paper was considered by the Fellows of the Royal Society to possess peculiar interest, as, since the year 1797, the subject had not been treated of, nor had any paper been read before that society: the experiments of Mr. F. Abel, of the Woolwich Arsenal chemical department upon gunpowder and other explosive compounds are, however, also of recent date.

We consider that Mr. Thomas has done good service by the very opportune publication of the present work, for the subject cannot be too thoroughly ventilated.

Theory of Compound Interest and Annuities, with Logarithmic Tables. By Fédoe Thoman. London: Lockwood and Co., 1859.

Although this volume is addressed to commercial men in general, its especial value will, we should think, be acknowledged by actuaries more particularly; certain it is, that the amount of labour and mathematical ability expended upon this work by the author is much greater than our courage in undertaking its careful perusal; we therefore honestly admit that beyond studying the contents, reading the editor's preface, and advancing through the introduction, we have confined ourselves to pursuing some of the examples of the application of given formulæ; but we are bound to acknowledge the vast amount of respect to which the opinion of so eminent a mathematician as Professor A. De Morgan in favour of this work is entitled.

Engineers of the Royal Navy. London: T. W. Holmes, Bridges-street, 1859. pp. 26.

This pamphlet is devoted to an exposition of the complaints of the Royal Naval Engineers. The grievances complained of, although not very numerous, are serious and important in character, and they should be met with prompt and courteous attention by the authorities at the Admiralty. It is several years since we first drew attention to the case of the Royal Naval Engineers, and the unsatisfactory condition in which this important section of our naval forces was placed with respect to the other officers in this branch of her Majesty's service. Want of space will, we learn, prevent the insertion this month of some remarks upon this subject which it was intended should be given elsewhere.

[We are compelled, for want of space, to omit the insertion of other reviews and notices.—Ed.]

LIST OF NEW BOOKS AND NEW EDITIONS OF BOOKS.

ACKERS (G. H.)—Universal Yacht Signals. pp. 330, cloth, 10s. (Hunt.)

HOPKINS (M.)—A Handbook of Average: for the use of Merchants, Agents, Shipowners, Masters, and others; with a Chapter on Arbitration. 2d edit., pp. 500, cloth, 15s. (Smith and Elder.)

JERVIS (Captain.)—Our Engines of War, and How we got to Make them. Post 8vo., pp. 120, cloth, 6s. (Chapman.)

BROWN (G.)—A Treatise on the Railway and Canal Traffic Act 1854, and on the Law of Carriers as affected thereby. pp. 102, cloth, 5s. (Maxwell.)

MAURY (M.)—The Physical Geography of the Sea. Post 8vo., pp. 330, cloth, 5s. (Lowe.)

PHOTOGRAPHY—A Catechism of Photography; including simple Instructions for Performing all the various Operations connected with the Art. 12mo., pp. 104, cloth, 1s. (Cassell.)

STEVENSON (D.)—Sketch of the Civil Engineering of North America. 2d edit., 12mo., pp. 226, cloth, 3s. (Weale.)

THOMAS (L.)—Rifled Ordnance. (Weale.)

*MAURY (M.)—Explanations and Sailing Directions, to accompany the Wind and Current Charts, approved by Captain Ingraham, chief of the Bureau of Ordnance and Hydrography. Vol. 2, 8th edit., enlarged, and 7 Plates. (Lowe.)

WATERSTON (W.)—A Manual of Commerce: being a Compendium of Reckoning Tables, Exchange, Simple and Compound Interest, &c. Also an extensive Collection of Short Commercial Forms, and a Glossary of Terms of Trade and Finance. pp. 310, half-bound, 3s. 6d. (Simpkin.)

*FRENCH—Farm Drainage. The Principles, Processes, and Effects of Draining Land with Stones, Wood, Plows, and Open Ditches, and especially with Tiles; including Tables of Rain-fall, Evaporation, Filtration, Excavation, &c., &c., and more than 100 Illustrations. pp. 384, cloth, 6s. 6d. (Lowe.)

*REPORTS of EXPLORATIONS and SURVEYS to ascertain the most practical and economical route for a Railroad from the Mississippi River to the Pacific Ocean, made under the direction of the Secretary of War in 1853-6. Vol. 10, 4to., plates, pp. 583. (Lowe.) (Washington, 1859.)

*ESTERBROOK and MONCKTON—The American Stair Builder; containing a complete Exposition of the whole subject of Planning and Constructing. Oblong Folio. (New York, 1859.) 36s. (Lowe.)

* These are American publications.

NOTICES TO CORRESPONDENTS.

Q.—We advise you to apply to Messrs. Penn and Sons, Greenwich.

J. C.—We are at a loss to understand the meaning of some of your enquiries. Some of your questions are very foggy.

T. Z. C.—Mr. Eaton Hodgkinson is the author of the paper referred to; he has made numerous experiments on the strength of materials. His address is 44, Drayton-grove, Brompton. S.W.

Andrew R. Gray.—A letter has been received with your initials dated from Plymouth. Did you succeed?

D.—"Thetis."—You are correct as to the condenser, but you are in error as to there being any difference with respect to the position of the air-pump; whether vertically or horizontally disposed. Air-pumps, if properly designed, placed, and speeded, should give as good a vacuum when placed horizontally as vertically; but the practice connected with air-pump designing in the north has been much more extensively in the vertical than the horizontal form or arrangement of pumps. The following letter has been received from Professor Rankine, relative to a statement in the concluding paragraph given in The Artizan last month:—

"STEAMER 'THETIS.'

"*To the Editor of* The Artizan.

"Sir,—At the conclusion of the extract from my report on the steamer 'Thetis,' which is published in your journal for August, the following sentence is printed so as to appear to be part of the report:—'They have an air-pump by which they lose 1lb. of vacuum.' That sentence, however, is not in my original report, and I do not know its origin; but most probably it is an explanatory note, which, by an oversight in copying or printing, has been made to appear to belong to the text. The vacuum was undoubtedly injured in the manner stated, but to what extent I am unable to say precisely.

"In explanation of the shortness of the experiment, it is desirable that the public should be informed that it was interrupted by a fog, whose increasing thickness made it necessary to return to Greenock. "I am, Sir, your most obedient servant,

"Glasgow, 4th Aug., 1859." "W. J. Macquorn Rankine."

P. Rose.—Many thanks for your offer, but we are already engaged.

T. T.—We have endeavoured to obtain the information you required, but unsuccessfully.

T. W. N.—Your letter has been received, and we shall be glad to see you as soon as possible. No time should be lost in acting upon the suggestion.

T.—Mr. Silver, the inventor of the Marine Governor which bears his name, is still in the United States; but Mr. Hamilton, of 8, Royal Exchange-square, Glasgow, can supply you with the information required.

R. T. S.—Mr. J. Beattie, of the South Western Railway, Mr. Lees and Mr. Jenkins, of the Lancashire and Yorkshire and East Lancashire Railways, and numerous other locomotive engineers, and others, have been devoting their time and attention to the alteration of locomotive engine furnaces for the economic use of coal instead of coke. Mr. D. K. Clark, too, has very successfully applied himself to the subject; and although he has a plan of his own invention, which answers admirably, you cannot do better than put yourself in communication with him, as we know no one so thoroughly posted up in locomotive matters as Mr. D. K. Clark.

P. S.—Mr. Henry Tyson, Locomotive Superintendent of the Baltimore and Ohio Railway (or, as he is styled, the "master of machinery"), has already published such returns as those which you suggest. We hope to give space for the returns in our next.

Apprentice, Old Subscriber, Inquirer, T. Johnson, O. H., and others, whose letters were received too late to enable us to reply in the present number, will be answered in our next.

G. Gross (Brake).—We will reply to your enquiry by post.

Burnt Bar.—Address Mr. Gray, Eagle-cottage, Park-road, Peckham. We cannot really tell you anything more about the matter.

M. G. M.—"The Artizan Treatise on the Steam Engine," by John Bourne; and Bourne's "Catechism of the Steam Engine;" Tredgold on the "Steam Engine;" the last edition published by Weale, High Holborn, &c. &c. You had better apply to E. and N. F. Spon, 16, Bucklersbury; John Weale, 59, High Holborn; and Hebert, 88, Cheapside, for a catalogue from each; and, moreover, they will advise you on the subject.

T. Maynard.—We should be happy to answer the numerous enquiries made in your letter, which are more of a professional character than we are usually expected to treat of in our notices to correspondents; indeed it is somewhat unfair to expect us to give an amount of information for which naval architects and engineers are usually (and very properly) highly paid.

SHIP BUILDING ON THE CLYDE, AND AT OTHER PORTS.

IRON SCREW STEAMER "QUEEN."
Built by Messrs. Robert Napier and Sons, Glasgow, 1854. Registered anew 13th July, 1858.

	Tons.	
Register	$199\frac{87}{100}$	
H.P. 70		
	Ft.	tenths.
Length	159	9
Breadth	22	1
Depth	12	8
Length of engine-room	28	3
	Tons.	
Tonnage of ditto	$94\frac{05}{100}$	

Demi-female figure-head; no galleries; clinch-built; round stern; standing bowsprit; two masts; schooner-rigged; one deck; Samuel Steel, commander; station, Dundee and Hull; 2nd station, Dundee and Hamburg; owners, Dundee, Perth, and London Shipping Company.

IRON SCREW STEAMER "LONDON"
Built by Messrs. Gourlay Brothers and Co., Dundee, 1856. Registered 5th July, 1856.

	Tons.	
Register	$423\frac{08}{100}$	
H.P. 140		
	Ft.	tenths.
Length	208	9
Breadth	28	2
Depth	16	$0\frac{1}{2}$
Engine-room, length	33	0
	Tons.	
Tonnage of ditto	$199\frac{09}{100}$	

DESCRIPTION.

Scroll figure head; no galleries; elliptical stern; clinch-built; 1 deck and a poop; standing bowsprit; 3 masts; schooner-rigged.

Commander, Duncan Buick.

Owners, Perth and London Steam Navigation Co.

Station, Dundee and London.

CLYDE AND WEST INDIA SAILING BARQUE, "SEA HORSE."
Built by Messrs. Robert Steele and Co., Greenock, 1859.

DIMENSIONS.

Builder's measurement.	Ft.	in.
Length of keel and fore-rake	125	0
Breadth of beam	26	0
	Tons.	
Tonnage	$393\frac{36}{94}$	
Customs' measurement.	Ft.	tenths.
Length on deck, outside of stem and stern-post	128	0
Breadth (extreme)	26	2
Depth of hold	16	1
Length of quarter-deck	29	0
Breadth of ditto (mean)	18	6
Depth of ditto	2	$5\frac{1}{2}$
Tonnage.	Tons.	
Hull	$335\frac{35}{100}$	
Quarter-deck	$13\frac{92}{100}$	
Total (register)	$348\frac{97}{100}$	

DESCRIPTION.

A seal figure-head; square-sterned and carvil-built vessel of timber; no galleries; 3 masts; standing bowsprit. Official number of ship 25,092.

Port of Greenock.—Owners, Messrs. John Lamont and Co. Classed 13 years A 1, at Lloyd's. Launched January 4th.

Commander, Mr. John Campbell Bailey.

LONDON AND CHINA SAILING-SHIP, "FALCON."
Built by Messrs. Robert Steele and Co., Shipbuilders, Greenock, 1859.

Builder's measurement.	Ft.	In.
Length of keel and fore-rake	190	4
Breadth of beam	32	1
	Tons.	
Tonnage	$936\frac{57}{94}$	
Customs' measurement.	Ft.	tenths.
Length on deck (outside stem and stern-post)	191	4
Breadth	32	3
Depth of hold	20	$1\frac{1}{2}$
Tonnage.	Tons.	
Hull	$729\frac{41}{100}$	
Houses	$64\frac{37}{100}$	
Total (register)	$793\frac{78}{100}$	

DESCRIPTION.

A demi female figure-head; round-sterned and carvil-built vessel of timber; 3 masts; standing bowsprit.

Owners, Messrs. Phillipps, Shaw, and Lowther. Classed 13 years A 1, at Lloyd's. Launched January 6th.

Port of London.—Commander, Mr. Peter Maxton (late of the *Lord of the Isles*).

TWO IRON BARGES,
The property of the Ganges Steam Navigation Company, Calcutta.
Built by Messrs. Robert Steele, and Co., Shipbuilders, Greenock, 1859.

Builder's measurement.	Ft.	In.
Length of keel and fore rake	200	0
Breadth of beam	30	0
Depth of hold	8	0
	Tons.	
Tonnage	$871\frac{26}{94}$	

Fitted with 7 bulkheads; round sterned; common bow. These vessels are sent out in pieces and reconstructed in India.

THE MERSEY STEAM-TUG COMPANY'S IRON PADDLE-STEAMER "ROVER."
Built and fitted with machinery by Messrs. Blackwood and Gordon, Engineers and Iron Shipbuilders, Paisley, 1857.

	Ft.	tenths.
Length on deck (outside stem and stern-post)	132	3
Breadth of beam	20	6
Depth of hold	10	2
Tonnage.	Tons.	
Gross	$186\frac{84}{100}$	
Engine-room	$117\frac{51}{100}$	
Register	$69\frac{33}{100}$	

Fitted with a pair of side-lever engines of 86 nominal H.P.; diameter of cylinders, 36 in. × 4 ft. length of stroke; diameter of paddle-wheels, effective, 16 ft. $6\frac{1}{2}$ in.; 14 floats, 7 ft. 6 in. × 1 ft. 3 in.; 2 tubular boilers, length, 10 ft. $11\frac{3}{4}$ in., breadth, 8 ft. $6\frac{1}{2}$ in., depth, 12 ft.; 4 furnaces, 6 ft. 8 in. × 3 ft. 7 in.; 252 tubes, diameter, $3\frac{3}{4}$ in. × 7 ft. 1 in.; 1 chimney, diameter, 2 ft. 8 in. 265 tons, O.M.

DESCRIPTION.

No figure-head, galleries, or bowsprit; 1 mast; sloop-rigged; 1 deck; round-sterned and clinch-built vessel.

Port of Liverpool.

THE LIVERPOOL & ROCK-FERRY STEAM PACKET COMPANY'S IRON PADDLE-STEAMERS "ANT" AND "BEE."
Built and fitted with machinery by Messrs. Blackwood and Gordan, Engineers and Iron Shipbuilders, Paisley, 1855.

Dimensions.	Ft.	ths.	Ft.	ths.
Length on deck (outside stem and stern-post)	122	6	122	4
Breadth of beam	18	1	18	1
Depth of hold	7	5	7	4
Length of engine-room	37	9	38	0
Tonnage.	Tons.		Tons.	
Total	$102\frac{47}{100}$		$103\frac{56}{100}$	
Engine-room	$37\frac{91}{100}$		$38\frac{32}{100}$	
Register	$64\frac{55}{100}$		$65\frac{24}{100}$	

Fitted with a pair of steeple engines (each vessel) of 54 nominal H.P.; diameter of cylinders, 30 in. × 3 ft. length of stroke; diameter of paddle-wheel, effective, 14 ft.; 14 floats; 1 tubular boiler, length, 10 ft. 5 in., breadth, 13 ft. 11 in., depth, 11 ft.; 4 furnaces, 7 ft. × 2 ft. 8 in.; 180 tubes, $2\frac{1}{2}$ in. × 6 ft. 4 in.; 1 chimney, diameter, 2 ft. 9 in. 170 tons, O.M. *Ant*, official number, 22,818; *Bee*, ditto, 22,827.

DESCRIPTION.

Double-bow, or sterned; no figure-head, galleries, bowsprit, mast, or rigging; 1 deck.

Port of Liverpool.

THE BOMBAY STEAM NAVIGATION COMPANY'S IRON SCREW STEAM-VESSEL "TILLY."
Built and fitted with machinery by Messrs. Blackwood and Gordon, Engineers and Iron Shipbuilders, Paisley, 1859.

Dimensions.	Ft.	tenths.
Length on deck (outside stem and stern-post)	184	5
Breadth of beam	24	$8\frac{1}{2}$
Depth of hold	13	$9\frac{1}{2}$
Tonnage.	Tons.	
Total	$455\frac{99}{100}$	
Engine-room	$166\frac{47}{100}$	
Register	$288\frac{82}{100}$	

Fitted with a pair of inverted cylinder (direct acting) engines of 90 nominal H.P.; diameter of cylinders, 40 in. × 2 ft. 3 in. length of stroke; diameter of screw, 10 ft.; pitch, 21 ft.; 3 blades; 2 tubular boilers, length, 11 ft. 3 in., breadth, 18 ft. $5\frac{3}{4}$ in., depth, 10 ft. 9 in.; 6 furnaces, 7 ft. 2 in. × 2 ft. $5\frac{5}{8}$ in.; 336 tubes, diameter, 3 in. × 7 ft.; 1 chimney, diameter, 4 ft. 2 in. × 25 ft. 8 in. Trial trip, March 26th; draft of water forward, 10 ft. × 11 ft. 6 in. aft; average revolutions of engines per minute, 68; speed of vessel, 11 knots.

DESCRIPTION.

A shield figure head; round-sterned and clinch-built vessel; 3 masts; barque-rigged; 1 deck, with poop and forecastle deck; standing bowsprit; clipper-bow.

Port of Bombay.—Commander, Mr. Wedge.

THE LIVERPOOL NEW STEAM-TUG COMPANY'S IRON STEAMER, "RESOLUTE."
Built and fitted with machinery by Messrs. J. W. Hoby and Co., Engineers and Iron Shipbuilders, London Works, Renfrew, 1857.

Dimensions.	Ft.	tenths.
Length on deck (outside stem and stern post)	161	0
Breadth of beam	24	8
Depth of hold	13	2
Length of engine-room	62	0
Tonnage.	Tons.	
Total	$374\frac{75}{100}$	
Engine-room	$289\frac{23}{100}$	
Register	$85\frac{52}{100}$	

Fitted with a pair of side-lever engines of 170 nominal H.P.; diameter of cylinders, 47 in. × 6 ft. length of stroke; diameter of paddle-wheels (effective), 23 ft.; 22 floats, 9 ft. × 1 ft. 6 in.; 4 tubular boilers, length, 11 ft., breadth, 9 ft., depth, 11 ft. 4 in.; 8 furnaces, 7 ft. × 3 ft. 3 in.; 512 tubes, diameter, $3\frac{3}{4}$ in. × 7 ft. 6 in.; 2 chimneys, diameter, 4 ft. × 28 ft.; heating surface, 3,600 sq. ft.; contents of coal bunkers, 200 tons; consumes 30 tons per hour; revolutions per minute, 22; speed, 12 knots; steam pressure, 20 lbs. per sq. in.; indicated H.P., 700; date of trial trip, July, 1857; classed 12 years A 1 at Lloyds'; 3 bulk heads. This is one of the finest towing vessels in the Merchant Service, having successfully towed the *James Baines* (one of the largest ships belonging to the Black Ball Ex-Royal Mail Line of Australian Packets, James Baines and Co., owners) from Liverpool to Portsmouth with troops, since which was sent out to the Atlantic in search of a missing vessel, and brought the vessel safely into Liverpool.

DESCRIPTION.

1 deck; 1 mast; sloop rigged; round sterned and clinch built; no figure head; galleries or bowsprit.

Port of Liverpool.

THE LIVERPOOL NEW STEAM TUG COMPANY'S IRON TOWING PADDLE STEAM-VESSELS, "RETREVOR" AND "RELIANCE."
Built and fitted with machinery by Messrs. J. W. Hoby and Co., Engineers and Iron Shipbuilders, London Works, Renfrew, 1857.

Names.	*Retrevor.*		*Reliance.*	
Dimensions.	Ft.	ths.	Ft.	ths.
Length on deck (inside stem and stern-post)	158	8	158	9
Breadth of beam	23	$2\frac{1}{2}$	23	$2\frac{1}{2}$
Depth of hold	12	0	12	0
Length of engine-room	62	0	62	0
Tonnage.	Tons.		Tons.	
Total	$300\frac{30}{100}$		$301\frac{7}{100}$	
Engine-room	$246\frac{14}{100}$		$246\frac{41}{100}$	
Register	$54\frac{16}{100}$		$54\frac{67}{100}$	

Both vessels fitted with a pair of side-lever engines of 142 nominal H.P; diameter of cylinders, 43 in. × 6 ft. length of stroke; diameter of paddle-wheels (effective), 22 ft.; 20 floats, 8 ft. × 1 ft. 6 in.; 4 tubular boilers, length, 10 ft., breadth, 8 ft. 6 in., depth, 10 ft. 4 in.; 484 tubes; diameter, $3\frac{3}{4}$ in. × 7 ft. 6 in.; 8 furnaces, 6 ft. 6 in. × 2 ft. 10 in.; 2 chimneys, diameter, 3 ft. 8 in. × 25 ft.; bunker's hold, 150 tons; consumes 25 tons in the hour. *Retrevor* trial trip, October; *Reliance*, ditto, December, 1857. Steam pressure, 18 lbs. per sq. in.; 22 revolutions per minute; speed, 10 knots an kour; indicated H.P., 550; classed 12 years A 1 at Lloyds'. These steam-tugs, including the *Resolute*, are the finest specimens of their class extant, for power and efficiency.

RECENT LEGAL DECISIONS

AFFECTINGTHE ARTS, MANUFACTURES, INVENTIONS, &c.

Under this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, aud to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.—Ed.

Coal-Mining.—Damage to House Property.—At the recent Summer Assizes, Oxford Circuit, Stafford, 23rd July, the owner and occupier of a public-house called the Three Furnaces, in Tipton, sued defendant, the owner of some mines under the land adjoining, called the Tipton Green, to recover damages for injuries done to plaintiff's inn and some cottages, by the mining operations of defendant, who began to work the thick coal near the plaintiff's property in 1856; and shortly afterwards plaintiff's property began to crack, the earth sank as much as 6 or 8 feet, and the drainage changed its course, and instead of running away from the house, ran into the cellars, and it became necessary to pump it ont. The jury found for the plaintiff, with 600*l.* damages in respect of the house and adjoining premises.

Glass-makers' Strike.—At Walton, Bell, & Co.'s plate-glass works, Stourbridge, twelve of the men engaged have been summoned for leaving work without notice. The defendants had objected to a foreman, who is a Frenchman. The only defence offered was that, by the custom of the trade, no notice was required. It was, however, proved that the custom of the trade was (where there was no special agreement), to give notice according to their "reckoning;" where they were paid weekly, seven days' uotice, and fourteen where the payment was fortnightly. Five of the defendants, as the ringleaders (the charge not being pressed against the others) were committed to prison for fourteen days.

The Gasmen's Strike.—On behalf of the Great Central Gasworks, on Bow Common, application was made, 1st August ult., to the Thames Police Court, for a summons against five men, described as the ringleaders of fifty others (firemeu, stokers, and scoop-drivers), in the company's employ, and who have left their work without notice. The magistrate (Mr. Selfe) doubted whether labourers employed in gasworks came within the meaning of the words of the Act 4 Geo. IV., cap. 34, which subjected to imprisonment and hard labour for three months "labourers and others" absenting themselves without leave, and without notice, before the period for which they were engaged shall have expired. The matter had repeatedly been discussed before judges and justices, as to whether all labourers, however employed, came within the meaning of the words "labourers or other persons." He would, however, grant summonses against the parties complained of, the case being one deserving a thorough investigation. Any objection to the jurisdiction could be discussed upon the hearing; the company's solicitor had contended that the magistrate had jurisdiction, the words of the Act including "servants in husbandry, artificers, calico-printers, pitmen, glassmen, potters, labourers, or other persons;" and that the Act applied to "contracts in writing, or not in writing."

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

We have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we sball derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "19, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

Admiralty Anchors.—In the House of Commons, 22nd July ult., it was ordered that there be added to the returns relative to anchors ordered on the 5th July ult., the names of any of her Majesty's ships in commission for the last two years, supplied with other than the Admiralty or established anchor of the Navy: also specifying what description of anchor, with any reports thereou.

Sewing-Machines.—The strike of the operative shoemakers in Stafford, which has now lasted for nearly five months, still continues. The dispute arose from the use of sewing-machines for boot-tops, which had previously been made by the wives and daughters of the workmen, who refused to make up machine-sewn tops: when it was (by the masters) decided to bring the sewing-machines into general use, the great mass of the operatives left the town. But they found the machine-sewn tops wherever they went; and it appears that the opposition of the workmen, however prolonged, will not, ultimately, prevent the use in the trade of the, to them, obnoxious machines.

Percussion-Cap Factories.—Fatal Explosion.—At Birmingham, 28th July ult., at 7 p.m., a disastrous explosion occurred at the manufactory of Messrs. Ludlow Brothers, Percussion-Cap Makers to the Board of Ordnance. The explosion took place in a room at the top of the main building, where the operation of mixing fulminating powder was carried on. The woman so engaged was blown and torn to fragments, no portion of her remains, larger than a person's hand, having since been picked up. A workman engaged in another part of the building was killed by the roof falling in. Another had both his legs broken, and a woman and several other persons in the factory were seriously injured. The premises were completely gutted, and thrown open to the sky. The explosion was heard at the distance of two miles.

The Glasgow Trade.—In the year ending June 30th ult., the foreign imports and exports at Glasgow were 165,816 tons and 257,250 tons respectively. The imports and exports coastwise in the same period, were 384,274 tons, and 460,719 tons, respectively. The gross total for the year was, cousequently, 1,268,059 tons; being an increase of 112,261 tons as compared with preceding twelve months.

The late [Warwick] Exhibition of the Royal Agricultural Society was the largest as regards the entries of implements, &c., which the Society has ever held; but the receipts from visitors' payments fell off slightly as compared with the Chester Meeting. At Warwick the receipts were 5,459*l.*, number of implement exhibitors 246; whilst at Chester they were, respectively, 6,187*l.* and 197.

Some extensive Rice and Flour-Mills at Liverpool, on the banks of the Leeds and Liverpool Canal, were, 26th July ult. completely destroyed by fire.

Ward's Naval Signalling-Apparatus.—At Woolwich Dock-yard, 26th July ult., Mr. W. H. Ward, of Auburn, United States of America, exhibited, by permission of the Lords of the Admiralty, his patent invention for transmitting messages, and carrying on correspondence of any length from ship to ship, becalmed or sailing, within telescopic sight of each other on the ocean, with equal facility to that of the electric telegraph on land. One of the instruments was erected at either end of a long enclosed lobby, adjoining the dock-yard factory, when a lengthened test of messages and replies was satisfactorily carried out. The experiment was conclusive as to the merits of the apparatus; and the invention we understand has been pronounced in official quarters one of the most important of the kind hitherto produced, and likely to be productive of immense benefit to the entire naval and merchant service afloat.

A Gigantic Steam-Hammer, combining various improvements on those hitherto in nse, has recently been completed at the Mersey Steel and Iron-Works, Liverpool. It weighs 32 tons 15 cwt.; total height, about 23 feet; absolute weight of the metal in the apparatus, 70 tons.

Fire-proof Copper Gauze, a recent invention, is about to be applied by the Society for the Protection of Life from Fire to all their present fire-escapes (for which there are about 70 stations in London) in order to render tbem impervious to flames.

The Earnings of the Trinity House Pilots in 1858 were, as we learn from a parliamentary return, 17,069*l.* in Dover; and 18,772*l.* in Deal.

Aerial Navigation.—The Great [American] Balloon Voyage (Transatlantic Trip), so much talked of for some months past, has at length been undertaken by Messrs. Wise, La Montaine, Gazer, and Hyde. The distance they accomplished was 1200 miles; time occupied nineteen hours. The balloon left St. Louis, on the Mississippi, one Friday evening, at 20 minutes past 7, and arrived at the termination of its career (not altogether, as we shall perceive, a completely successful one) at 20 minutes past 2 on the Saturday; having passed over in its course the entire length of Lake Erie, and crossing between Buffalo and the Niagara Falls. After leaving Buffalo, the aerial ship encountered a terrific hurricane, and was swept with great rapidity towards Lake Ontario, having lost its ascending power. After a fearful run of 50 miles, almost skimming the water, it reached the shore, and was ultimately brought up by the tall forest-trees it swept against in its course—the silk being torn into ribbons, and the gas—we are glad to add the adventurous aeronauts themselves too—escaping. The balloon was christened the *Atalantis*. Highest point attained during the voyage a little over 2 miles. It was charged with 75,000 feet of gas at starting: constructed at Lausingburg, for a voyage across the Atlantic. The trip cost Mr. Gazer alone some 2000 dollars.

Steam-Cranes, for hoisting Coal, &c.—On the deck of the *Great Eastern* are four small steam-winches, or engines, each of which works a pair of cranes, on both sides of the vessel. With these four double cranes alone, 5000 tons of coals can be hoisted into the vessel in 24 hours.

The Pneumatic Despatch Company Bill was, 10th August ult., considered, and ordered for third reading in the Commons.

The Stephenson Monument, by Mr. Lough, will consist of a bronze figure, 10 feet high, upon a gradually decreasing quadrilateral base, springing off a square area; height of supporting mass, 15 feet. The figures of four athletic workmen, modelled from the life, fill np each corner of the area; and they each are typical. First, a forge worker, a common blacksmith, with his implements of trade, on whose labour all the grand works of the mighty engineer were based; a second, bearing a sample of the smooth rail; a third, with the Locomotive Engine: and a fourth, with the safety-lamp, or, as the miners call it, "Geordy."

A New [Institution] Life-Boat for Whitburn, on the coast of Durham, was experimentally tried 25th July ult. Length, 32 feet; width, 7 feet 10 inches, on design of Mr. Peake: built by Messrs. Forrestt, of Limehouse. After capsizing, the water shipped was self-ejected through 6 relieving-valves in 25 seconds; with a crew of 13 and gear on board, her line of flotation found to be 5½ inches below decks. 23 men had to rest on the gunwale or side of the boat before it touched the water's edge. Trial in every respect satisfactory. She has been sent to her destination. Called the *Thomas Wilson*, in memory of one of the benevolent founders of the National Life Boat Institution.

The Locomotive Bill.—In the Commons, 25th July ult., the further consideration of this Bill was postponed in Committee; Sir C. Lewis remarking that at present they had not sufficient evidence to justify the application of locomotive engines to turnpike roads.

Explosion of Foul Air.—The drain at the head of Leith Wynd exploded 30th of July ult., through an accumulation of gas and foul air; blowing up a portion of the pavement, and throwing down a woman who was passing. She was not, however, severely injured.

Industrial Museum (Scotland).—In the Commons, 5th August ult., Mr. Fitzroy informed the Honse that plans were immediately to be prepared, and that as soon as these plans were completed the building would be proceeded with. It appears that the delay in this matter has arisen through a misunderstanding between the Board of Education and the Board of Works; that the site for a suitable building was secured ten years ago, and a large sum, nearly 10,000*l.*, has been granted, and yet not a stone laid of this building.

Gunpowder Mills Explosion.—At Messrs. Hall's, Faversham Gunpowder Mills, 8 p.m., 17th August ult., an explosion took place. Fortunately the whole of the hands had left work, and the damage was confined to the building. The accident occurred (as on a former occasion at tbese mills) in the "green-charge" rooms.

Another Explosion, attended with great destruction to human life, occurred 7th August ult., in the Ballincoleg Powder-Mills, Ireland. It took place about half-past 10 in the morning in the storehouse at the western extremity of the works, on the banks of the river, in No. 1, Dusting (Refining) House. Five men engaged removing the powder in kegs into a boat on the caual were blown to pieces. Of the "dusting-house" not a stone remained. Cause unexplained.

The Revival of the Polytechnic Institution, under the form of a company with limited liability, for hiring and working the old Institution, is confidently spoken of. On the 12th August ult., a meeting, having this object, and presided over by the Earl of Sbaftesbury, was held at Willis's Rooms, when a committee was appointed to carry out the plan alluded to.

The Patent Machine Boot and Shoe Company held their annual meeting 17th August ult.

The Electric Power Light and Colour Company met, on the 16th August ult., to receive the liquidator's report on the winding up.

Merchant-Shipping.—From an interesting return just published, showing the nnmber of vessels entered inwards and outwards, at each of the 12 principal ports of the United Kingdom, and also the official value of the imports and exports of each of the said ports during the year 1858, we find the following to be the tonnage of the vessels entered inwards at each of the ports named. London, 2,961,309; Liverpool, 2,320,334; Hull, 651,476; Bristol, 200,068; Newcastle, 712,235; Southampton, 299,389; Leith, 175,165; Glasgow, 127,594; Greenock, 98,369; Dublin, 119,748; Cork, 98,348; Belfast, 65,587: the aggregate of the 12 ports being 7,829,613. Values of the exports: London, 28,886,839*l.*; Liverpool, 50,899,668*l.*; Hull, 13,449,733*l.*; Bristol, 538,418*l.*; Newcastle, 1,863,976*l.*; Southampton, 2,242,907*l.*; Leith, 825,836*l.*; Glasgow, 5,193,164*l.*; Greenock, 545,989*l.*; Dublin, 59,722*l.*; Cork, 180,268*l.*; Belfast, 9,344*l.*; in all 104,695,864*l.*

The Compasses for the "Great Eastern," manufactured by Mr. J. Gray of Liverpool, were, 15th August ult., exhibited on the floor of the New Liverpool and London Insurance Buildings, Liverpool. They are of very large size and beautiful workmanship. The "Patent Binnacle" includes an ingenious apparatus for adjusting compasses on board a vessel of iron.

Explosion of a Naphtha Tank.—At the warehouse of Mr. Yeend, Ladybellegate-street, Gloucester, 6th August ult., in removing the tap from a metal tank which had contained naphtha, a pair of heated tongs was used for the purpose of dissolving the solder with which the tap was fastened; their application caused the tank to burst with great violence: the operator was thrown some distance, and severely burnt.

Boydell's Traction-Engine was recently tested in Hyde Park with satisfactory results. The engine, though somewhat less compact than that of Bray, is a beautiful specimen of machinery. It is fitted with peculiar mechanism (over the driving wheel), which forms an endless tramway. Though nominally of 12-horse power, the boilers yield steam for an indicator of more than double that amount; and the engine can with ease draw from 60 to 70 tons along ordinary turnpike roads at the rate of 4 miles per hour. At the trial on the 12th August ult., attached to the Boydell's machine were 5 powerful waggons, into which about 160 soldiers mounted, and were taken easily across the level parts of the park, at the rate of 6 miles an hour. For military purposes, such as getting up guns and siege-stores, an engine of this kind will, doubtless, prove a valuable auxiliary.

RAILWAYS, &c.

The Metropolitan Railway, Deviations, &c. Bill [Amendment], was, 1st August ult., read a third time, and passed in the Lords.

Great Southern and Western [of Ireland]. Dividend officially announced at the rate of 5 per cent. per annum, leaving a surplus of £11,800 to be carried forward. Dividend for corresponding period of 1858, was at the same rate.

The Victoria Railway Station [Pimlico], will cover ten acres of ground; not another foot could be obtained. The station is freehold, but there is a rent-charge of £3,000 to the Marquis of Westminster, to be redeemed.

Charing Cross Station and the South Western Railway. At the meeting of the latter company at their Waterloo Station, 4th August ult., the chairman stated that, "with respect to the Charing Cross Railway Station, the directors left the question of an extension thereto entirely to the proprietors. The directors did not think badly of their Waterloo Station, and the extension, if made, would only be done by incurring an enormous expense; and he also thought there were *certain difficulties* in the way, which would prevent its completion for a considerable time." Report agreed to.

The Tunnels at Mount Pleasant and Bridgenorth (for the Severn Valley Railway), have been commenced.

The Victoria Station and Pimlico Railway Bill was, 5th August ult., read a third time, and passed in the Lords. On the 13th August ult., it received the Royal Assent. As regards this railway, all the works are being carried out of sufficient dimensions to enable the broad guage to have access to the Victoria Station.

The Caledonian Railway.—Traffic return for the first week in August ult., showed a decrease of £247.

The Total Assessment of Railroads, under the Income Tax (in England and Wales), is £10,450,401.

The Kingincleugh Cutting, on the Railway near Mauchline Hill, has been flooded to a depth of six feet, by a waterspout, which fell with great violence on the Mauchline Hill, immediately above the village, which, together with the surrounding locality, was so completely flooded, that some of the inhabitants, whose houses were near the rivulet which traverses the village, only effected their escape by cutting a passage through the thatch.

The West End of London and Crystal Palace Railway Bill [No. 1.], was, 20th July ult., ordered for third reading in the Commons.

Railway Waggons for Russia. An order from the Russian Government for 100 of these has just been sent to Paris.

Canadian Railways. From Chicago to La Fosse, the railway is open, and 495 miles are making to Pembina, leaving only 1,160 miles of road to make, to Fort Langley, in British Columbia, from whence the distance to China is 5,800 miles, and to Sidney, 7,230.

The Grand Trunk Railway will be completed to Detroit in October next, and the Victoria Bridge, in November; when Canada will form the middle link between the Eastern and Western States of America. The distance from Quebec to Liverpool is 2,600 miles: and from thence to Chicago, by uninterrupted railway, 1,020 miles; total sea and land transit, 3,620 miles, being a saving of 400 miles, as compared with New York. In 1851, the number of railways that centered in Chicago, was only 40, and the traffic only £8,000; in 1855, the mileage of the Western Railways that centered in Chicago was 2,933, and the annual receipts from traffic were £2,659,640.

Indian Lines.—In the North West Provinces railway-passenger traffic has, by last accounts, been subjected to inconvenience and delay by reason of want of coal. Instead of coal, wood is, in consequence, generally used to work the locomotives.

The Cawnpore to Meerut Line (North West of India), was shortly to be opened to the public.

Of the Scinde Railway, a section is expected to be opened shortly, running from the harbour of Kurrachee to a navigable creek on the Indus.

For the Indus Steam Flotilla (Scinde Railway) six steamers and thirty-three barges are in course of shipment at Liverpool. The whole flotilla, comprising in all fifty-six vessels (including steamers and barges), is expected to be on the Indus in the early part of next year. The flotilla is calculated to be capable of carrying about 20,000 tons per year: each of the seven large steamers, with her complement of barges, will be able to carry a complete regiment of soldiers, together with their baggage.

For the Punjaub Railway (between Lahore and Umritsir), all the permanent-way materials for this section were, per last advices, on their way up the country, in the country boats, some hundreds in number.

The Madras Lines.—The contracts of this company with the Government, comprehend about 850 miles of railway, consisting of the main line, running south-west from Madras to Beypoor, on the Malabar coast, and its branches to Bangalore and the Neilgherry hills, making together about 515 miles, and the Bellary, or north-west line, extending from the Arconum station, 42 miles from Madras, on the main line from Cuddapa and Bellary, to Moodgul where it will form a junction.

The Expenditure for the Indian Railways for the next financial year is (by Sir C. Wood, in the Commons, 1 August ult.), estimated at £8,000,000; and the amount which has to be raised for them will be £6,000,000, leaving a balance to be provided for of £2,000,000, which forms part of the total deficit (in Indian revenue), of £12,500,000. To meet this deficit, however, the Chancellor of the Exchequer disclaimed any intention of reducing the expenditure for public works in India, adding that some alteration might probably be made "without stopping those works which are of large public utility."

The Interest on the [Indian] Railway Capital, paid into the Treasury, which interest is a charge on the Indian revenue, amounts to £1,114,000, of this the Government expect to receive, as revenue of the railways already finished, £200,000, in the course of the year, which will leave £900,000 as the real charge on the Government, with the Great Indian Peninsula Company's line, coming from Bombay. Its length will be about 330 miles. The main line has now been for some months open, as far as the station of Goriattum, 96 miles from Madras. Its junction opening has been unexpectedly retarded by the non-completion, "through unforeseen difficulties of construction," of the bridges over the Goriattum and Palar rivers.

Railway through-communication across the [Indian] Peninsula, from Coromandel to the Malabar Coast, 405 miles in length, will, it is now confidently expected, be completed by this time next year, the central part of the Madras line being in a forward state, all the permanent-way materials required from England being in store, and, with the exception of the bridges, the works of the line not being generally of a heavy character. There are no tunnels, and not many heavy cuttings or embankments.

The Bangalore Branch (of the Madras railway), which the engineers are now engaged in setting out, forms a junction with the main line at a point about 150 miles from Madras, ascends to the table-land of Mysore, and, having reached the level, passes on to Bangalore, a distance of 81 miles. The steepest gradient will not exceed 1 in 81, with moderate curves.

To the Foot of the Neilgherry Hills [proposed branch], will start from the main line, near Coimbatoor, and be from 28 to 30 miles in length.

The Bellary, or North West Railway will branch from the main line at Arconum, 42 miles from Madras, and proceed by Cuddapa, Gooly, and Bellary, to the town of Moodgul, where it is to form a junction with the Bombay line. Entire distance (from Madras), upwards of 370 miles. Estimated capital required (including rolling-stock), £2,500,000.

For the Madras [Main] Line, the share-capital raised at present consists of £1,500,000 5 per cent. stock, £1,000,000 4½ per cent. stock, and £500,000 4½ per cent. stock, together £3,000,000, leaving £1,000,000 of the estimated capital till to be raised.

The Bombay, Baroda, and Central India Railway Company Bill, was read a third time, and passed in the Commons, 5th August ult.

From Toulon to the Italian Frontier, with a branch to Draguinan, and another branch from Privas to Crest, the concession for a railway has been granted to the Mediterranean Company.

The Pernambuco [Brazil] Railway Works (late advices), are being pushed vigorously forward, notwithstanding the rains, by the company's new engineer, who has 1,300 men at work. The works have resisted the action of the rains remarkably well.

The Vincennes Railway is now completed to the Place de la Bastille.

The Great Luxembourg Railway Receipts (on the line from Brussels to Namur), amounted, for the year 1858, to £56,431, and the working expenses to £23,217, leaving a net balance of £33,213. As regards the section from Namur to Arlon, opened for traffic throughout on the 8th November last, some misunderstanding has arisen between the directors and the Belgian Government, respecting the sum actually due to the company under the State Guarantee of 1852, of a minimum annual revenue of £32,000. From Arlon to the frontiers of Luxembourg, the extensive line is announced for opening for traffic very shortly, thus ensuring uninterupted access to the city of Luxembourg and to the Strasburg railway by Thionville. The engineering works, both on the railway and on the canal, have been of an unusually difficult and expensive character. Upon one of the embankments alone, 1,000 cubic yards of ballasting a week, had to be thrown to keep it in order. When the traffic has been developed, and the junctions are effected with the North and South of Europe, the Meuse will be joined with the Rhine and the Moselle, Holland with Luxembourg, and the whole line with the systems of France and Prussia. In Luxembourg itself, coal, iron, and lime-stone are abundant.

Between Namur and Brussels, on this line, the traffic amounts to £1,200 a week, gross receipts.

The Coal-traffic of Charleroi and Liege will be carried as far as Metz.

Railway Accidents:—

Sardinian [Piedmontese] Lines.—Voltri to Savona.—The *Piedmontese Gazette Royale* recently authorized the Concession, to Messrs. Peto and Wagstaff, of a railway to be constructed between Voltri and Savona, in Piedmont.

Cape of Good Hope.—In the Cape Town and Wellington Railway, the Governor has consented to an important deviation of the line. Instead of passing in a straight line from Salt River to Eerste River, it is now to follow a direction parallel to the main road, and then bend to Eerste River, across Kuil's River.

From Cape Town to Wynberg, a railroad is projected, with a capital of £100,000, to be raised, it is expected, in the colony.

Uncoupling Horse-Boxes.—On the North Eastern Railway (Malton station), a porter, uncoupling some horse-boxes, whilst stepping out between the lines of rail, was caught in the back by the buffer of an engine approaching on the other line, knocked down, had one foot cut off, skull fractured, and otherwise injured.

In a Tunnel.—At Godstone Station, on the South Western Railway, a young man incautiously coming through the Bletchingly Tunnel, for a short cut home, was found (in the tunnel), with both feet and one side of his head cut off, and otherwise frightfully mangled.

Off the Rail into a Bog.—On the North Eastern Line, 6th August ult., about two miles on the Pickering side of the incline, at "Fen Bogs," where the line is carried across an extensive swamp on piles, as the noon train from Whitby was passing, the engine ran off the rails, and plunged overhead into the bog, pulling the train after it. Engine-driver and stoker both buried in the bog, along with the engine, but both were rescued by the passengers; both injured, but not very seriously. Cause attributed to the heat of the sun having twisted the frame-work of iron and caused the rails to rise here and there unequally.

Collision.—At Fenchurch-street Terminus of the Tilbury Railway a serious collision took place, about 2.30 p.m., 1st August ult. A Tilbury train arrived at the station, and the engine, having been detached, crossed over on to another line, and was returning through the lower end of the station on its way to the turn-table, when it came in fearful collision with the carriage of a North Woolwich train which was coming in, dashing into two of the carriages, and severely injuring the passengers. Engine and train both knocked off the line.

At the Darcey Station (Côte d'Or) on the Lyons Railway, an accident took place recently, at night, by which two persons were killed, and twenty others more or less seriously injured. Two trains, filled with troops, were proceeding in the same direction, when the one behind, going too fast, ran into the other.

A Collision in a Tunnel took place recently at Port Glasgow. A luggage-train ran into a heavy passenger one. About 100 out of 500 passengers were more or less injured.

The Walsden Tunnel, on the Lancashire and Yorkshire Railway, on the 7th August ult., was flooded by the late rains. The scene of the disaster was a little down the valley, at the entrance to the tunnel, where a culvert under the line was unable to carry off the water, and the stream made a clean breach over the rails, washing upon them great quantities of *débris* from the hill-sides, and seriously impeding the traffic for many hours. The 7.40 p.m. in train, from Manchester to Leeds, was detained at the mouth of the tunnel an hour and three-quarters before it could proceed into Yorkshire.

Crossing the Rail.—On the Eastern Counties Railway, 11th August ult., near the Little Ilford Station, a man who was incautiously crossing the line, was knocked down by the engine of the Chelmsford train, and killed on the spot.

The Official Return shows the grand total of accidents to passenger trains during the half-year, ending the 30th June, 1859, to have been 25; while to all trains together, it was only 27. Number of persons killed in consequence of these accidents, 7; all being companies' servants. As to the number of "deaths on railways" generally, the greater number were killed on level crossings, or while trespassing on the line. Including these deaths, the total number killed by railway accidents in the United Kingdom in the six months ended the 30th June, 1859, was 128. Injured during same period, 198. Of the killed, only 1 was a passenger; 8, by want of caution; 9, were railway servants, killed by causes beyond their own control; 51, want of caution; 15, by crossing at level crossings; 39, by trespassing on lines; deaths of remaining 5 not satisfactorily accounted for. Number of persons killed in Ireland during same period, 13. In Scotland, 16.

Defective Fastenings to Carriage-doors.—Recently, while the Parliamentary Train from Glasgow was approaching Corstorphine, at a speed of 26 miles an hour, a boy of about six years of age fell out of a third-class carriage upon the embankment, owing to the door of the compartment not having been properly fastened. The child sustained but slight injury; but a female passenger, who had, on the impulse of the moment, thrown herself out of the carriage to save the boy, was much more seriously injured.

The Total of Killed and Injured on Railways of the United Kingdom open for traffic during the half-year ended 30th June, 1859—was, 60 killed and 33 injured. Of this number, 9 persons were killed and 11 injured by accidents the causes of which were beyond their own control; while 51 were killed and 22 injured from want of caution, or misconduct. There were killed 4 engine-drivers, 8 firemen, 10 guards, &c., 7 porters, no policemen, 4 gatekeepers and signalmen, 2 switchers, 7 platelayers, and 7 labourers.

Of Collisions on Railways, and other accidents to trains on railways in England, Wales, Scotland, and Ireland, during the same period, there were 27 (25 to passenger, and 2 to goods-trains); and by these accidents, 9 persons were killed and 159 injured. No passengers were killed, but 149 were injured; 12 of the accidents were due to collisions; 7 to trains getting off the rails; 4 to fracture of axles, wheels, or machinery; 1 to running too fast into a station; and 2 to trains catching fire, against which most frightful contingency there appears to be but little security.

Sparks from Engines.—In alluding to two accidents from fire, which occurred on the North-Western Line, on the 11th and 21st April last, the recent Official Report states that both accidents were "doubtless caused by sparks from the engine," and that "the proper precaution is, to abandon the practice of carrying luggage on the roofs of carriages, instead of in covered vans. That the burning of coal in engines, moreover, has increased the liability of luggage to be ignited; and endangers wooden viaducts and bridges not adequately protected."

Trenails outside Curves.—The accident on the North Western Line on the 26th February last, when the engine went off the rails on the outside of an S-curve, about ¾ths of a mile radius, and about ¼th of a mile beyond the foot of the incline, about a mile from Leamington, affords, says the above Report, another instance of the small dependence that can be placed on the resistance of trenails, outside a curve, to a bursting pressure when any casualty interferes with the regular action of an engine; the speedy remedy of this defect is urged on all the curves of the line. The engine, on occasion of this lamentable accident, was "No. 8," one of Sharp's 22-ton engines. It was received in 1847; and its mileage is returned as having been 238,000 miles to the date of the accident.

MARINE STEAM ENGINEERING.

The "Great Eastern" is ready for sea. Her engines are now erected, the propeller in its place, and the floats on the paddle-wheels. Her machinery is so far complete, that steam for trial has been got up to try accuracy of bearings, and so forth. Of her six masts, the 1st, 5th, and 6th are in and rigged. Deck-bulwarks up—and the painters giving the boards a first coat. Deadlights nearly all in. So far advanced, indeed, that she will probably be taken to sea before the end of autumn.

Russian Screw Frigates.—At the naval review, held at Cronstadt, on the 23rd July last, by the Emperor Alexander, of the steam fleet (which was drawn up in two lines, and consisted of 21 men-of-war and frigates, and a number of gun-boats), the screw-frigate, *Grand Admiral*,* recently constructed in America for the Emperor, attracted particular attention. Only four years since, the Russian Navy possessed only one screw frigate the *Palkane*, which remained stationary at Cronstadt.

The "Adelaide" Steamer, Royal Mail Steam Navigation Company, Galway Line, made her recent home passage from St. John's, Newfoundland, in 6 days 13 hours. Left New York, 21st July ult., St. John's, 26th, reached Galway 10 a.m., 2nd August ult.

The Panama Route.—The necessity of establishing an additional Mail-steamer Service by this route has been lately much insisted on in the mercantile world, in consequence of the repeated delays experienced in the arrival of the Australian steamers, with the Calcutta and China Mails, at Suez; whereby great inconvenience has been caused to parties connected with the Australian trade.

The "Collingwood," 80, arrived, 2nd August ult., at Chatham, to be fitted for a screw steamship.

The "Orlando," 50, screw steam-frigate, at Devonport, was, 3rd August ult., ready for sea.

The Turkish Line-of-Battle Steamship "Shadia" is under the crane at Keyham, receiving her boilers.

Coasting Steamers.—Pilotage.—The Board of Trade are desirous that the Pilotage Committee of the Mersey Dock Board should undertake the examination for Pilotage Licenses of Coast Steamers. This the Committee have hitherto declined to do. The Board of Trade continue to insist; and some serious, not to say angry correspondence has recently taken place between the parties on the subject. Should this misunderstanding continue, it will, not improbably, end in the appointment, by the Government, of an Examining Board to act independently of the Mersey Pilotage Committee. In the meantime, the Committee, 4th August ult., consented to reconsider their determination. Here the matter for the present rests.

The Steam Navy.—Of the 120 vessels (exclusive of mortar vessels and floats) now lying in ordinary in the Royal Navy, 17 are to be converted into screw ships; and the conversion of seven others is under consideration. Four ships have been broken up or sold since January, 1830, without having been commissioned.

Launching of large Steamers, &c.—In his address on the recent occasion of trying the engines of the *Great Eastern*, Mr. Scott Russell, alluding to the early expensive and ineffectual attempts to launch the monster steamer, said, "the plan tried was one which, he considered, ought never to have been adopted. It would never, he hoped, be resorted to again for the launching of any ship. The *Great Eastern* might have been launched with a great quantity of grease and oil upon smooth oak planking; a mode which succeeded every day in practice. In future, therefore, whenever any large ship like this was constructed, it would not be at all necessary to invent any new method of launching; but simply to adhere to the good old plan of ship-builders—of oak planking, and plenty of oil and grease."

The First Trial both of the Screw and Paddle-Engines of the "Great Eastern" Steamship took place 8th August ult.—the former by Boulton and Watt, the latter by Mr. Scott Russell. The paddle engines consist of four oscillatory cylinders, of 74 inches diameter, and 14 feet stroke; each pair of cylinders, with its crank, condenser, and air-pump, forms, in itself, a complete and separate engine, capable of every disconnection with the other three; so that the whole is a combination of four engines. A friction-clutch connecting the two cranks connects or disconnects the two. The paddle engines work up to an indicated power of 3000 horses, of 33,000lbs. when working 11 strokes per minute, with steam in the boiler at 15lbs., the expansion valve cutting off at one-third of the stroke. The engines, however, will work smoothly, either at 8 strokes per minute, at 25lbs. without expansion (beyond what is unavoidably effected in the slide), or at 16 strokes a minute, with the expansion-valve cutting off at one-fourth of the stroke, when the paddle engines alone would give an indicated power of 5000 horses. Weight of boilers, including donkey-engine, pumps, funnels, &c., 210 tons, capable of containing 156 tons of water. Each set has about 8000 square feet of tube-surface, exclusive of flue or furnace, and about 400 square feet of fire-bar surface. Each is equal to supply freely with moderate firing steam for an indicator of 1800 horse-power when working with 15lbs. but, with full fires, can supply an indicator of 2500 horse-power. Fireplaces and ash-pits fitted for the use of anthracite coal. The Screw Engines have four cylinders of 84 inches diameter, and 4 feet stroke, capable of being worked together or separately. When working 45 strokes a minute, with steam on at 15lbs., and cutting off at one-third of the stroke, these engines give an indicated power of 4400 horses; but, at 55 strokes a minute, with steam on at 25lbs., and cutting off at one-fourth of the stroke, the power will reach to 6000 horses. United power of both screw and paddle engines equal 12,000 horses at driving rate of from 22 to 23 miles an hour. Weight of screw-engine boilers (in three distinct sets) 362 tons; joint capacity for water 270 tons; probable consumption of coal (both engines at full work) 250 tons per day (average). At starting, steam in boilers, about 21lbs., and engines, turning but slowly, did not exceed 6 revolutions per minute. The great mooring-chains astern were tightened to the utmost. The screw engines were then set in motion, working the ship astern, so as to counteract the effect of the paddles. The screw engines worked with marvellous ease and freedom; no noise, no sign of hot bearings; and result of trial (which had been merely for getting up steam and trying engines, &c., and not for a trial trip) perfectly satisfactory to the numerous eminent engineers assembled on board. The absence of Mr. Brunel (through continued illness) was deeply regretted by all present on board to witness this great triumph of engineering skill.

The Russian Steam-fleet, reviewed on the 23rd July ult., at Cronstadt, by the Emperor, accompanied by the Grand Duke Constantine, Grand Admiral, consisted of the following war-steamers, chiefly screws. Line-of-battle:—*Constantine, Viborg, Prokhor, Sinope, Orel, Cesarevitch, Vola.* Frigates, &c.:—*Generale Admirale, Illia Mourumetz, Svetlana, Khabri, Grosiachtchii, Calevala, Posadnik, Kamptchatka, Olaf, Rasboinik, Naezdnik Petersburg, Fontanka, Standarte* (T. yacht), and a numerous flotilla of gun-boats, nearly the whole of which are screws. The whole of these ships have been built since the war.

The "Galatea," new Steam-frigate, 26, building at Woolwich, is ordered to be launched on the 14th of September instant.

Iron Masts for Steamers.—The three centre square-rigged masts of the *Great Eastern* are of iron, made by Mr. Finch, of Chepstow; each is of hollow wrought iron, in 8-feet lengths, strengthened inside by diaphragms of same material; between the joints, as they were bolted together, was placed a pad of vulcanized India-rubber, which gives a strength and buoyancy to the whole spar greater than wood, while at the same time retaining all the strength of the iron. The breaking-strain of the six shrouds to each of these masts is over 300 tons, which gives ample security for the masts being properly supported, as the weight of each is only 22 tons.

The "Modern Greece," a fine Steamer, 1200 tons burthen, with engines of 400 horse-power, now being finished at Stockton-on-Tees by Messrs. Richardson and Co., has been purchased by the Greek and Oriental Steam Navigation Company, as an addition to their fleet of steamers. Her engines are fitted with the super-heating steam apparatus. Intended for the London and Mediterranean trade; will leave shortly for her first voyage.

Statistics of Steamer Traffic, British and Foreign. In 1844 the total entrances and clearances of British steamers amounted to 998,664 tons: in 1849, to 1,428,807 tons: in 1858, to 3,484, 391 tons. Of Foreign steamers, in 1844, to 171,093 tons: in 1849, to 308,185 tons: and, in 1858, 753,231 tons.

Casualties to Steamers:—

Wreck of the "Alma."—No hopes are now entertained that this stranded steamer will ever be rescued from her position on the Mooshedjerah Reef, in the Red Sea, where she struck on the 25th June ult. By latest reports, she is cracked on the port side, just before the funnel, and the fissure was seven inches wide; her bottom is also reported to be torn out; and she will inevitably go to pieces in the first strong southerly gale. Subsequent report states that the crack in the hull has widened considerably, and that the stock of coal was being hauled out through it.

The "Malta" was still (14th July ult.) at Aden, disabled, waiting for her new machinery.

The missing "Columbia" (Peninsular and Oriental Mail Steamer) had not made her appearance at Aden to the above date.

Collision with an Iceberg.—An Accident to the Cunard Royal Mail Steamship "Canada," with the English mails of the 2nd on board, occurred 9th July ult., at 1.30 p.m., when, being then about 230 miles off the Banks of Newfoundland, in Lat. 48° 40′ N., Long. 48° 10′ W., and during a dense fog, she ran foul of a large iceberg. Her passengers escaped injury, but the steamer lost her bowsprit, cutwater, head-gear, &c. On the 12th she arrived at Boston, U. S., where her necessary repairs were to be executed. The immense iceberg was not perceived until about 300 yards from the ship, which was going full speed, with all steam on, and with mainsail and yards set. Engines immediately stopped, but only a minute and a quarter elapsed before she struck, crushing and splintering the bowsprit like a reed, annihilating the cutwater, tearing up the forecastle deck, and staving in the bows of the ship. Fortunately, she struck on a perpendicular face of the berg, and not where it extended under water, so that the principal damage to the bows was above the water-line. This circumstance, joined to the extraordinary strength of the ship, saved her from going down at once with the intensity of the shock, as was most probably the fate of the *President, Pacific,* and *City of Glasgow.*

The "Columbian," Royal Mail Steamer (Peninsular and Oriental Mail Company), with the May mails, had to return to Adelaide disabled, whence, having been repaired, she finally sailed for her destination on the 1st June last.

The Steamer "Lady Sale," which left Malta some weeks ago, to repair the cable between that place and Cagliari, has been forced to put in to Marsala, with damage, but left on the 21st July, to resume operations, so as to splice on the two ends the stouter cable which she brought out from England over the spot where a rupture had twice occurred, and where coral reefs and volcanic action are known to exist.

The Total Loss of the "Alma" (Peninsular and Oriental Company's steamer), which recently went ashore in the Red Sea, is by subsequent advices, confirmed, she having parted "amidships." She registered 2160 tons, with engines of 450 horse-power. Her cargo consisted almost entirely of silk, of which 1400 bales, worth about £120,000, have been lost.

The Wreck of the "Paramatta" Steamer.—A statement in the American intelligence, to the effect that this steamship, stranded on the 30th June last, on the Onagada Reef, had been got off, is held to be unfounded. By later authentic accounts, on the 19th July ult., she was still on the reef, the efforts to get her off having been frustrated by the weather. She had worked herself upright by grinding away the rock on which she is lying. Hopes were entertained that this noble steamer might ultimately be got off.

A Steamboat Collision on the Thames occurred, 1st August ult., between the half-penny steamboat *Endeavour* and the steamer *Snipe*. The *Endeavour* was on her passage down with a large number of passengers, when, near Dyer's Hall Pier, she was run into, stem on, by the *Snipe*, Woolwich steamboat. The concussion was so violent as to smash the sponson, paddle-box, and paddle, damaging the machinery, and carrying away a great portion of the upper works. The *Jupiter*, halfpenny boat, received the terrified passengers, and landed them safely on the pier. The *Endeavour* was hauled up for repairs at the Adelphi Pier.

* The Russian name of this steam-vessel is *Generale-Admirale*—the other screw frigates reviewed on this occasion were the *Ilia Mourometz* and the *Svetlana*. Amongst the paddle frigates, the *Grosiachtchii, Khrabril, Kamtchatka,* and *Olaff.*

The "Firefly," Paddle-wheel Steam-vessel, lying off Woolwich Dockyard, under orders to sail 5th August ult., on survey of the Channel Islands, was, 4th August ult., run into by a collier brig, passing up the river, and was damaged to such an extent as to delay her departure.

The Steamer "Harbinger," as we learn from the Cape of Good Hope, had, June 25th ult., to put back to Algoa Bay, leaky, and with loss of foremast and jibboom.

A Fatal Collision near the North Foreland, occurred Sunday, 6th August ult., between the Dublin steam-packet and a collier. During a dense fog the collier came against the steamer as she was going into the Downs. The former was completely cut in two. The captain of the steamer succeeded in saving five of the collier's crew (of nine), four being drowned—namely, mate, pilot, mate's son, and a seaman.

TELEGRAPH ENGINEERING, &c.

Submarine Telegraphs.—In the Commons, 25th July ult., on the motion of Mr. H. Berkeley, an address to the Crown was agreed to for copies of any contract entered into by her Majesty's late Government for the laying down a line of Submarine Telegraph Communication between England and Gibraltar; of any correspondence between the Contractors and Government relating thereto; and the proposals of the Great Indian Submarine Telegraph Company for carrying out a line from Falmouth to Bombay, viâ Gibraltar, Malta, and Alexandria, either as a whole or in sections.

For Insulating Telegraphic Wires (Submarine) a new process has been proposed. India-rubber is used as the insulating agent, and permeability to water is said to be prevented by immersing the coated wire in bisulphuret of carbon and chloride of sulphur.

England and Denmark.—The Submarine Telegraph Company's cable from Weybourne in England, to Heligoland and Denmark, has been placed in telegraphic connection with Cromer, in Norfolk, and Westerhever, on the Danish coast; and signals have been interchanged.

France.—Between Cherbourg and the different Forts of the Roadstead, and the advanced or fortified points of the coast, an electric cable has been laid down.

The Electric and International Telegraph Company, at their half-yearly meeting, 29th July ult., declared a dividend at the rate of 6½ per cent. per annum, leaving a surplus of 6690*l.* out of the half-year's earnings. This balance, prudently enough we think, was carried to the credit of the fund available *inter alia* "for the renewal of cables."

The Folkstone and Boulogne Cable, now laid, is submerged at Boulogne; thence traverses the depth of the Channel, and emerges at low-water mark opposite Lydden Spont Station. From this it passes under the beach to the zig-zag footpath ascending the cliff to the station, and is thence carried on by an underground wire to an office in Folkstone, near the pier, lately occupied by Messrs. Chinnery. It is connected with Dover by means of a wire from its junction at Lydden Spout to the company's office, passing, at a considerable height, above houses from Archcliff Fort. The cable weighs six tons to the mile.

Submarine Telegraph Contracts.—In the Commons, 1st August ult., the Chancellor of the Exchequer notified the intention of the Government to suspend all proceedings with regard to telegraph contracts until the report of the Select Committee upon the Packet and Telegraphic Service was laid upon the table of the House; with the exception, however, of one case, in which the manufacture of the cable had actually commenced before the present Administration came into office, and which would go on. As a general rule, however, "so far as the Government were able to do so," no further proceedings would be taken.

Between Adelaide and Melbourne (South Australian advices to the 1st June ult.) telegraphic communication was interrupted by damage from a violent storm.

Holyhead and Liverpool.—The engineer reported to the Mersey Dock Board, 4th August ult., that the poles had been placed in the ground at a point within three miles of Point Lynas, and that the wires had been carried to within six miles of that place. It was expected that the line would speedily be completed as far as Point Lynas, and that electric communication would at once be opened from Holyhead to the Great Ormshead.

The Mediterranean Extension Telegraph Company held their half-yearly meeting 6th August ult. Operations were recently commenced for the repair of the cable between Malta and Cagliari, but were interrupted by severe weather. In the present state of affairs the directors did not consider it advisable to declare a dividend.

Relative Merits of Submarine Cables.—The Board of Trade are about to engage in a number of important experiments, with a view to secure the best description of cable for submersion between Falmouth and Gibraltar, with an ultimate extension to Malta. Mr. R. Stephenson and Professor Wheatstone are to have the direction of these experiments, which are to be conducted jointly by the Government and the Atlantic Company. The experiments will consist of complete tests, by pressure and otherwise, of the comparative insulating qualities of gutta-percha and India-rubber, as well as the comparative value of external coverings of iron, of hemp, and of hemp and iron in conjunction. A thorough chemical examination will also take place into the respective constituents of these two substances to test their comparative durability, as well as their liability to be acted upon by the salts of the ocean, or other influences, chemical or accidental.

Ward's "Telegraphic Apparatus Signal Light," noticed in our last, applicable either for the field or the navy, consists of five lamps arranged in the form of a diamond: each letter of the alphabet being represented by a red or white star at a certain point of the diamond, as indicated by a pre-arranged code of instructions.

Malta and Cagliari.—Damage done to the cable ascertained not to be at the Malta end, which is stated to have proved in perfect working order. Interruption still continues. The amount earned for messages for the half-year ending June 30th, 1859, was 1365*l.* 15*s.* 6½*d.* The cable broke about the 10th of February, and had been then at work about six weeks. The Government has only been called upon to pay 200*l.* to make up the [guaranteed] 6*l.* per cent.

Malta and Sicily.—The Mediterranean Extension Company have entered into a contract with Messrs. Glass and Elliott, of Greenwich, who have engaged, for 12,100*l.*, to lay the new line at their own risk and peril by the 20th of September, 1859. The specification for the cable was drawn up by Sir C. Bright. Shore-ends exceedingly thick; consequently when laid down anticipated to be very little liable to damage. It is hoped that this second line between England and Malta will prevent any stoppage of messages.

Between Cherbourg and the different Forts of the Roadstead, and the advanced or fortified points of the French coast, an electric cable has been laid down.

AGRICULTURAL ENGINEERING.

At the Royal Agricultural Society's Warwick Meeting, 13th July ult., the award of 50*l.* was made to Mr. Fowler for his "Set of Steam Cultivating Apparatus and Balance Four Furrow Plough." The engine which had been at work with Smith's and Fowler's tackle were again to be subjected to the break; the prize apparatus is therefore declared to be "the most economical application of steam-power to the cultivator of the land."

Paris Reaping-Machines.—The competition for the prize proclaimed for the best Reaping-Machines came off at Fouilleuse, near St. Cloud. The Emperor was present. A wide extent of harvest-land had been divided in batches of wheat, rye, and barley. The machines were classed under two distinct heads,—the Foreign Machines, and those of French manufacture. The prizes for each division were the same, 1000 francs and a gold medal, the first prize; 500 francs and a silver medal for the second: moreover, a large gold medal, as the honorary prize for the best machine, whether French or Foreign. This prize, as well as the first in the foreign division, fell to Messrs. Burgess and Key, whose machine, worked by two horses, caused much surprise. The harvest fell before it with a decision and regularity never attained by human band. It was the only machine in the field capable of being worked by only one man, and by admeasurement it was ascertained that this Reaper could clear an hectare of ground in one hour and a half.

The Three Mowing Machines (Burgess and Key's, Wood's, and Howard's), exhibited at the recent Warwick Meeting, worked most satisfactorily. In each case the acre appears to have been cut within the hour.

In the Agricultural-Machinery Division (yard allotted for machinery in motion) at the above meeting, the novel and truly interesting spectacle was presented of not less than 39 engines at work at one time.

Savery's [of Tewkesbury] Combined Thrashing Machine, which obtained the silver medal, includes a straw-maker and other improvements; and, what is of chief importance, it is of so simple a character that even an inexperienced farm-servant may use it without risk of injury.

Of the Chaff-Cutting Machines [36 exhibitors of these], that of Messrs. Richmond and Chandler, of Salford, has for its main new feature steel knife-pieces harder than the knives, and which cannot be worn away by friction, offering always a straight sharp edge for the knives to cut against.

A "Thatch-Fabricating Machine" (for making Thatch for Cottages and Farm-buildings), patented, was amongst the novelties exhibited at the recent Warwick Agricultural Meeting. This Machine [invented by Mr. Moody] can be worked by one man and a boy, the latter acting as "feeder." The straw is placed into receiving-springs, somewhat on the principle of the ordinary shuttle, and is tacked together by a series of wires, and formed into substantial thatching at the rate of 30 yards per hour.

An [Agricultural] "Atmospheric Hammer" obtained the silver medal. This Machine is worked by a small portable engine, and the blow of the hammer given by atmospheric pressure can be increased or diminished as required. It is specially adapted to the forging of iron-work connected with agricultural implements generally. The atmospheric pressure is 7 cwt.; that of the cylinder, which gives the blow, 3 cwt.; making together a combined pressure of half a ton.

Amongst the Prizes offered at the recent Warwick Agricultural Show, as connected with Tillage machinery and implements, were the following:—For the best application of Steam-power to the cultivation of the soil, 50*l.*; Ploughs, 40*l.*; Harrows, 20*l.*; Cultivators, 20*l.*; Rollers, 10*l.*; Falet Brick Machines, Draining Machines and Implements, 20*l.*; Clod-Crushers, 10*l.* For the invention of any new Implement such sum as the Council might deem proper.

Romaine's Steam-Cultivator, weighing 14 tons, and which was moved by steam-power from its trough on its arrival at the railway station, and proceeded through the streets of Warwick to its destination, was the subject of general surprise and admiration to the assembled groups (chiefly country people) who witnessed its arrival and subsequent progress.

Portable Railways for Agricultural Purposes.—The *Nouvelle Gazette de Prusse* announces the discovery of a new species of railway, applicable more especially to the transporting of manure, lime, &c., and to the more speedy conveyance of farm-produce, namely, a moveable railway composed of detached lengths of double-rails 15 feet in length, about 3 in breadth, pinned on to timber supports, and capable of being securely locked together. This discovery, it is added, bids fair to enable agriculturists to dispense with the necessity of rural roads.

HYDRAULIC ENGINEERING.

The "Hydraulic Lift," at the new Thames Graving-Dock, consists of 2 parallel rows of 16 cast-iron columns, each 5 feet in diameter and 60 feet in length, sunk into the ground, under the water, about 12 feet. These columns are 20 feet apart in each row, and the clear space between the two rows is 60 feet. Each column contains a hydraulic press 10 inches in diameter, and of 25 feet stroke, the top of the press being at the ordinary level of the water. The ram of each press carries a small crosshead, from which are suspended, by means of descending rods, two wrought-iron girders 60 feet in length, which extend entirely across the Dock, with corresponding column and press on the opposite side. There is thus a series of 32 suspended girders, which extend entirely across the Dock, and when the presses are lowered, lying at the bottom of the Dock in 28 feet of water, really forming one large wrought-iron girder, which, by means of the presses may, with a vessel upon it, be raised out of the water, or lowered, at pleasure. The vessel to be docked is not raised directly upon the gridiron, but upon a wrought-iron pontoon, proportioned to the size of the vessel to be docked. This pontoon is first placed upon the "gridiron," and sunk with it to the bottom of the water; then the ship is brought between the columns and over the pontoon, and a 50-horse engine, working the hydraulic presses, raises the gridiron, the pontoon, and the vessel altogether until they are clear of the water. The pontoon now empties itself of water through valves provided for the purpose; the valves are then closed, and the gridiron being again lowered to the bottom, the pontoon, with the vessel seated upon it, is left afloat on the surface.

For Cleansing the Serpentine, Steam Pumping-Engines and Filtering Apparatus (on the plan suggested by Mr. Hawksley, namely, for pumping out the water and restoring it when filtered), are to be erected in Kensington Gardens. The Pumping-machines will be used for 200 days in the year, and the expense will be only 1*l.* a-day. The vote (17,000*l.*) for this purpose was agreed to in Supply, 4th August ult., Sir J. Paxton and Sir J. Shelley objecting thereto on the ground of the difficulty of estimating the expense of the plan, and of the disfigurement of the Park by the proposed erections of the Steam-Pumping-Engines near Albert-gate.

Another plan proposed in Committee, was to treat the Serpentine as had been done in the case of the water in St. James's Park, viz., by draining it and concreting the bottom; which plan, however, was objected to by Mr. Fitzroy, as being doubtful in its result, whilst the expense of it might be unlimited.

WATER SUPPLY.

A Scarcity of Water in Dublin has given rise to a recent advertisement from the Corporation, in which they state that "the supply of water to the sources from which the City is supplied has become deficient," and in consequence they have to press on the citizens the urgent necessity of economizing the use of water in every way possible.

The Eastbourne Water Bill passed the Commons 26th July ult.; 1st August ult., a second time in the Lords, and in the Lords 5th August ult.

The Wirral Water Bill received, 1st August ult., the Royal assent.

At Chatham Garrison orders have been given to have the camp where the troops are now under canvas supplied with water from the waterworks. Pipes have accordingly been laid down to the Spur Battery, and a bountiful supply of water is thus placed at the service of the men, whose sanitary condition will doubtless in consequence be much improved.

Free Drinking Fountains.—Requisites.—The Free Drinking Fountains Association have adopted a series of recommendations to the public regarding the particular objects which, in the construction of a Street Drinking-Fountain, in their opinion, ought to be kept in view. Amongst these are—Insulation of the pipes, filter, &c., so as to preserve the water from the extremes of heat in summer, and cold in winter; occupation by the Fountain of the least possible space in the great thoroughfares of the metropolis; the yielding of small stream of continually flowing pure and cool water, most easily accessible to the greatest number of people; the re-filiation of the water in the Fountain itself. Each Fountain, consequently, being so constructed as to contain a filter, which shall be easily accessible at all times. Each Fountain to be provided with a ball and cock cistern, so as to prevent the waste of water.

DOCKS, CANALS, &c.

The Caledonian Canal.—According to the annual report just issued, the receipts, from all sources, from the 1st May, 1858, to 1st May, 1859, amounted to £5,080 1s. 6d., and the total payments, during the same period, to £6,951 9s. 11d., being an excess of payments to the extent of £1,871 8s. 5d. The report alludes to the formidable opposition offered to a ship canal by the increase of railway conveyance.

The Crinan Canal.—The above report also alludes to the fate of the sister (Crinan) canal, which has been "overwhelmed by a great disaster" since the last report. A reservoir burst; the banks of the canal, of course, gave way, and a general *débâcle* was the consequence. The estimate of certain proposed improvements, according to Mr. Walker, Civil Engineer, is £80,000; but it may be doubtful whether this cost will be incurred. Notwithstanding the disaster, by which the traffic of the canal has been almost wholly suspended for three mouths of the year, the receipts of the canal, from the 1st of May, 1858, to the 1st of May, 1859, amounted to £2,238 1s. 6d., and the payments to £2,149 15s. 10d., showing an excess of receipts of £88 5s. 6d.

The Sunderland Docks Bill [No. 2] passed, 26th July ult., in the Commons.

At the London Docks, an extensive fire occurred, 26th July ult., at the south end of the Eastern Brandy Vaults. Some 30 or 40 dock hands, who went into the cellars for the purpose of reaching the fire, were struck down by the heated vapour and became insensible. It was at first feared that they would all perish, as the lamps of the men who first went down were instantly extinguished by the bad air. These men were rescued, however, though one, who fell overboard, was killed by the poisonous nature of the water.

The Stokes Bay Pier [and Railway] Bill was, 28th July ult., read a third time in the Lords.

St. Katherine's Dock.—The tonnage which entered this dock in the first six months of the last three years was as follows:—1857, 93,781 tons; 1858, 93,636 tons; 1859, 97,962 tons. The dividend announced for the last half-year is 4½ per cent., free of income-tax.

Port of London.—The total shipping which entered the Port of London in the half-years ended 30th Juue, 1857, 1858, and 1859, respectively, was as follows:—1857, 4,378 ships, of 1,116,850 tons; 1858, 4,899 ships, of 1,295,840 tons; and 1859, 4,639 ships, of 1,195,240 tons.

The "Shoring" of Vessels, in the new Thames Graving Dock, is effected at a great saving of the labour and cost attendant on "shoring" for docking, repairs, &c., on the old plan. The work is accomplished by large moveable frames or sliding-wedges, which, while under the water, are drawn into close contact with the vessel, so that she sits on a huge timber cradle, without possibility of being strained; so that, in less than 40 minutes, a vessel drawing 18 or 20 feet of water is thus left afloat on a shallow pontoon, drawing only 4 or 5 feet, and may be taken in one of the eight shallow docks, where convenient workshops, with tools and shelter for the men, are provided for working close up to the bulwarks of the vessel.

The Swansea Harbour Trust Bill, 1st August ult. received the Royal assent.

A New Harbour at Beypoor is to be constructed, the Madras Government having resolved to take immediate steps for that purpose, so as to secure sufficient and safe landing, accommodation, and means of shipment for the overland mails and passengers.

The Great Luxembourg [Railway] Company's Canal is in progress. The net revenue from the small part of it opened for traffic amounts [Report to August ult.] to £858. Since the close of the year 1858, the works of the canal, for a distance of 16 miles, have been completed.

The Portsmouth New Dock Bill received, 1st August ult., the Royal Assent, as did likewise

The Stokes Bay Pier [and Railway] Bill.

The Total Assessment of Canal Property to income-tax (in England and Wales) is £302,765.

The Galway Harbour and Port Act Amendment Bill passed through Committee, in the Lords, 8th August ult.

The Swanage Pier [and Tramway] Bill was, 1st August ult., read a third time, and passed, in the Lords.

The Sunderland Docks [and Wear Navigation] Bill received, 1st August ult., the Royal Assent.

The New Dock at Brentford, in connexion with the Great Western Railway, by means of a branch (4½ miles) from the main line at Southall, has been recently opened. The dock, which is exactly opposite one of the entrances to Kew Gardens, where a ferry has long existed, covers 4½ acres of water, having a depth of 13 or 14 feet at high water, and an ample depth to float barges at low water. There is every convenience, such as covered sheds, cranes, tilts, turn-tables, traversing-frames, and all necessary plant; so that shipment of goods may take place with the utmost rapidity. This new dock promises to afford great convenience for conveyance of heavy traffic to and from the Pool. Hitherto, all the heavy traffic on the Great Western Railway, destined for the Port of London, has left the main line at Bull Bridge, whence it has been taken down the Grand Junction Canal to Brentford. To obviate this incouvenience, the new branch line (from Southall), and the dock in connexion with it, have been constructed.

At the Woolwich Dockyard and Marine Infirmary Building Establishments, the works were from the evening of the 6th August ult. at a stand-still, the whole of the building labourers and mechanics employed there by the several contract firms being informed that their services would not be required until the firm of Messrs. Trollope and Co. commenced work. Upwards of 3,000 men are, in consequence, for a time unemployed.

The New Wet Dock at the Port of Silloth was opened 3rd August ult. Length about 600 feet; width 300 feet; two pair of entrance-gates, with 60 feet opening; at spring-tides, the dock will contain 25 feet of water; a magnificent jetty extends for 1,000 feet into the sea; jetty and quay walls are connected by rails with the railway station.

The Walsal Canal burst, morning of 9th August ult., by the giving way of the embankment of that portion of the arm of the canal which lies between the gasworks and Marsh-lane, at a spot close to a worked-out shaft. The earth, too, gave way all round the shaft, soon presenting the appearance of a yawning gulf. The arm of the canal was speedily drained, and the main canal, for a considerable distance, was deprived of water; numerous boats were overturned and staved, and the wharf works were brought to a stand-still. Supposed cause of accident, the extensive undermining that had been carried on near the spot, by which the support was taken away from the shaft and the embankment of the canal arm.

The Suez Canal undertaking appears to be likely to assume an entirely new phase. By late advices from Alexandria, an agreement has been effected between M. de Lesseps and the Viceroy of Egypt, by which the rights and property of the Suez Canal Company, should the same be wound up, are to be transferred to the viceroy, who, in that event, undertakes to repay the shareholders in full. Nothing is said as to the future intention of the Egyptian Government to carry out the scheme.

The Foundation-stone of the Patent Slip at Simon's Bay, Cape of Good Hope, would, by last advices, be laid by the Governor, on the 14th July last.

BRIDGES.

The whole Cost of Westminster New Bridge, it was recently officially stated in the House of Commons, would (with the approaches) be about £500,000. The value of the Bridge Estates was about £150,000; so that £350,000 would have to be found from some other source, either county rates or, more probably, the Consolidated Fund.

The Blackburn and Preston Bridge [and Road] Bill was, 26th July ult., read a second time in the Lords.

The Swanage Pier [and Tramway] Bill was, same day, read a second time in the Lords.

The Cauvery [River] Bridge, near Errode (240 miles from Madras), for the section between Salem and Coimbatour of the Madras Railway, is the most important engineering work on the Malabar Coast Railway Line. Length between abutments 510 yards; openings, 22 in number, of 50 feet wide each; to be spanned, at the height of 50 feet above the bed of the river, by iron girders, placed on stone piers. Piers well advanced, and ready to receive the girders when they are sent up from Madras, where they now are.

The Old Wooden Bridges on the Guilford Junction [South Western Railway] have been removed, and have been replaced with new ones constructed of bricks.

The New Bridge from the Tuileries Gardens to the Quay d'Orsay (hitherto named Pont de la Légion d'Honneur), is henceforth to be called Pont de Solferino.

The Sarnia [Floating] Bridge across the river Sarnia, in connection with the Grand Trunk [Canada] Railway (extension from Port Sarnia to Detroit) is nearly completed.

The Finfoad Bridge Bill passed the Commons 21st July ult.

On London Bridge entirely new granite trams have been introduced by the side of the footways, the whole length of the bridge.

New Westminster Bridge.—In Committee of Supply, 4th August ult., the vote of £482,000 "for erecting the new bridge at Westminster and the approaches thereto," was, after some discussion, agreed to, as well as an additional sum of £40,000, solely for the approaches; Mr. Fitzroy stating, in answer to a question on the subject, that if any dependence could be placed on the statements of engineers, he had their testimony that the sum specified would be sufficient for the completion of the Bridge and approaches. In the Lords, 5th August ult., the Bill passed through Committee; and 13th August ult., it received the Royal Assent.

The Victoria Bridge, Montreal, it is fully expected, will be opened for traffic, as announced, on the 1st November next. The works on the two extreme sections of the Grand Trunk Road are advancing with great rapidity. The western section (including the extension from Port Sarnia to Detroit, as well as the section below St. Thomas), will probably be opened earlier.

The Victoria Station Bridge across the Thames is progressing favourably. In two of the three piers in the river, the foundations have been laid, and the masonry is considerably advanced towards the springing of the arch. In the third pier, the piling for the coffer-dam is completed, and preparations are being made for the commencement of the masonry. In the two abutments the coffer-dams have been already finished, and the excavation for the north abutment is well advanced. The progress of the works has been greatly expedited by the carrying the gantries and temporary staging completely across the river. All the masonry required for the construction of the bridge is on the ground and ready dressed. Earthwork completed, except a small quantity at the North end of the Thames Bridge, and part of the filling of the canal basin. The retaining wall of the canal is completed.

For the Severn Bridge (Severn Valley Railway), the foundations are in progress.

Nearly all the Wooden Bridges on the railway near Marykirk, Montrose, have, according to the *Montrose Review*, been declared insecure by the Government Inspector. The railway (local) authorities deny the truth of the rumour. The necessity of a speedy official contradiction, or assent to the truth of which, is insisted upon.

The Viaduct at Marykirk, Montrose, is, on the same authority, also declared to be in an insecure condition.

For the Victoria Park Approach Bridge, the tenders sent in to the Metropolitan Board of Works (for its construction), and opened for adjudication 12th August ult., were as follows:—Hockston, £4,843; Mordish, £5,188; Moxon, £5,800; Delhick, £5,950; and Peto and Betts, £8,435. Lowest tender (Hockston's) accepted, subject to the usual inquiries.

Fall of Walton Bridge.—This structure, leading from Walton to Halliford, Middlesex, was, at half-past 5 a.m., 11th August ult., observed to be cracking (across the highway of the bridge, over the centre arch), and the crack kept increasing so much as to allow parts to fall into the river; and so it remained, dropping bit by bit, until 12 o'clock, when the arch fell, with a violent crash, into the bed of the river. In a short time afterwards, the other arch fell in also, with the same violence, without injury to any person or property. Altogether, about 300 yards of the roadway fell in. The bridge was of brick, with stone piers and buttresses.

The Hungerford (Suspension) Bridge is to be transferred to the Charing Cross Railway Company, on the terms of guaranteed stock (of the Bridge Company) being maintained for 10 years, and payment of an additional sum of £100,000, making a total payment by the railway company of £125,000,—viz., £40,000 for the bridge property, exclusive of the tolls; and £85,000 as ascertained compensation for the tolls. Total receipts for the year ending 31st July, 1859, £6,460 18s. 6d.; outgoings, £5,089 15s. 3d.; leaving a profit upon the year of £1,371 3s. 3d.; mortgage and bond debt of the company now reduced to £13,500.

ACCIDENTS FROM MACHINERY, &c.

A piece of Iron weighing nearly a Ton fell recently (at Messrs. Marcs' Shipping-yard, in the Victoria-road), upon a working man, and severed his legs from his body; he was removed to Poplar Hospital.

An Accident at a Ropery at Sunderland (Messrs. Douglass and Co., Proprietors), occurred 1st August ult., to a young woman, by her right hand becoming entangled amongst the machinery—and before the engine could be stopped, her hand was nearly torn off, and her arm severely lacerated.

Accident in a Factory at Messrs. Emmott and Sons, Clegg-street, Oldham. A "piecer" had been a spinner to repair a strap; when, seeing that it hung loosely, and clung to the shaft, he took hold of it to put it right. In so doing, he got entangled in it, and was instantly carried round the shaft, his legs being dashed against the top of the room; both his legs were broken below the knee; his right arm broken in two places; left arm also broken. Removed to the Manchester Infirmary.

Mills, Foundry, &c., flooded.—By the recent great flood at Todmorden, serious damage was done in that populous manufacturing town, and much engineering property destroyed or seriously injured. In addition to the water which came down into the valley from the hills, two *crevasses*, one in the river Calder, and one in the canal, contributed considerably to swell the flood which poured in upon the town. The cotton-mill of Mr. Chambers was flooded almost to the top of the looms, work in the looms, machinery, contents of dyevats, &c., spoiled. The extensive foundry of Mr. James Nuttal was under water to a depth of between 3 and 4 feet, and suffered considerable damage. Mr. William Fielden's mill was also flooded, and sustained damage—as did also the machine-shops of Messrs. Lord, Brothers; indeed there was scarcely a mill or workshop in that part of the valley but suffered damage from the flood.

Fumigating Ships.—Two seamen have recently been suffocated on board the *Malcolm*, lying in Shields Harbour, in consequence of going below, and sleeping there, contrary, as it is alleged, to orders, while the ship was being smoked to destroy vermin.

GAS SUPPLY.

The Sale of Gas Bill passed through Committee (with slight amendments) in the Commons, 11th August ult., and on the 13th August it received the Royal Assent. The Act does not come into operation till ten years after its passage through Parliament; after which it will be compulsory on all parties to have their meters stamped, the salaries of inspectors to be paid out of the county-rates. In the Lords, 12th August ult., the Commons amendments to this Bill were agreed to.

Gas Companies Workmen.—Apprehended Strike.—Towards the close of last month, so great was the dissatisfaction felt from causes that have not been fully explained—

amongst the workmen employed in the Metropolitan Gas-Companies' Works, that a general strike was considered imminent. The misunderstanding, however, was so far arranged, that the Metropolis has been spared the threatened inconvenience of being suddenly left in darkness. On the 29th July ult., the men of the Vauxhall Gas-Works struck for an advance of wages, and a reduction of their time of labour; the whole body, about 100 in number, proceeded to the City Gas-Works, Dorset-street, Whitefriars, and subsequently to the Phœnix Gas-Works, Bankside, to induce the men there to turn out; but, as it appears, without success.

Gas-Meterage.—Frauds in Supply.—The value of gas sold in the United Kingdom is estimated to amount to £5,000,000 per annum; and yet its measurement is left without any legal provision with respect either to accuracy or fraud. What is called a cubic foot of gas measured by meters of one manufacturer differs as much as 3 per cent. from the cubic foot, as measured by the meter of other manufacturers. Gas-meters are capable of being managed so as to register for or against the consumer, as much as 25, or even 50 per cent.; instances have been found of meters actually at work, registering as high as 30 per cent. variation from the true measure. The remedy for this evil to the gas-consuming public would be to have a proper legal standard of measurement established, inspectors being appointed to enforce its observance.

The Bury St. Edmunds Gas Bill, 1st August ult., received the Royal Assent—as did likewise—

The Tottenham and Edmonton Gas Bill, and

The London [City] Gas Bill.

The Tottenham and Edmonton Gas Bill passed in the Commons 26th July ult.

The Kingston-upon-Thames Bill received the Royal Assent 25th July ult.

The London [City] Gas Bill was, 26th July, ordered for third reading in the Commons.

The Total Assessment of Gas Works to the Income-Tax (in England and Wales) is 843,060*l.*

The Gosport Gas Company have reduced the price of their gas from 6*s.* to 5*s.* 6*d.* per 1000 cubic feet, with 6*d.* per 1000 for the meter, being a reduction of 6*d.* to the consumer.

The Worcester Gas Company have declared a dividend of 7 per cent.

GAS ENGINEERING.

Lighting Picture Galleries by Gas.—The report of Professors Faraday, Hoffmann, Tyndall, &c., the Commissioners appointed to consider this subject was, 21st July ult., presented to the House of Commons. The Commissioners find nothing innate in coal-gas which renders its application to the illumination of picture galleries objectionable. Its light, though not so white as that of the sun, is equally harmless; its radiant heat may be rendered innocuous by placing a sufficient distance between the gas-jets and the pictures, while the heat of combustion may be rendered eminently serviceable in promoting ventilation. Coal-gas may be free from sulphuretted-hydrogen compounds; and in London is so at the present time; it then has little or no direct action on pictures. But it has not, as yet, been freed from sulphide of carbon, which, on combustion, yields sulphurous acid-gas, capable of producing 22½ grains of sulphuric acid per 100 cubic feet of, present, London coal-gas [Hoffmann]. The Commission are emphatically of opinion, that in every system of permanent gas-lighting for picture or sculpture galleries, provision should be made for the effectual exclusion or withdrawal of the products of combustion from the chambers containing the works of art. Certain colour-tests, consisting of surfaces covered with white-lead, or with vegetable and mineral colours (especially the more fugitive ones), and in which also boiled linseed-oil, magylp, and copal varnish were employed as vehicles, had been prepared, and were, when dry, covered, one-fourth with mastic varnish, one-fourth with glass, one-fourth with both mastic varnish and glass, and one-fourth left uncovered. Sixteen of these had been placed for two years in different situations, in some of which gas had been used, in others not. Seven of these showed chemical change in the whites, due (according to their respective situations) either to a town atmosphere, or want of ventilation; but they give no indication respecting the action of coal-gas. Whether exposed in galleries, &c., where no gas is used, or in situations where gas is frequently used, the trial-surfaces present no observable change in this respect. In conclusion, the Commissioners recommend that this kind of trial, "which is especially a painter's experiment," should be continued for a longer period, and, indeed, be carried out on a more extensive scale.

A Gas Kitchen, capable of cooking a dinner for 40 persons, has been erected by Kimbersley, of Birmingham, in conjunction with the new dining-hall recently erected at the Stafford Station of the London and North-Western Railway, expressly for the accommodation of the passengers by the Scotch trains, known as the "Scotch Express."

Gas for Ship-Lights.—Experiments, said to have been successful, have been made on this subject on board several steam-ships at Woolwich Dockyard.

MILITARY ENGINEERING.

A new description of Embrasure was, 23rd July ult., tested by experiment at Fort Monetin, near Portsmouth, Sir John Burgoyne, Inspector-General of Fortifications, and other high military authorities, being present to witness the proceedings. The immediate space round the mouth of the embrasure is formed of pigs of iron bolted together in the strongest possible manner. The outer space is formed of iron plates, with an outside facing of brick-work, several feet thick; the parapet, arch, and other portions of the work on the inner face of the battery being built in the usual manner. The practice at the embrasure was from an eight-inch gun, with solid shot, and a charge of 16lbs. of powder, at only 400 yards range; at this distance the shot broke into fragments, making an indentation on the pigs of iron of 1¾ inch. Where the shot struck the brickwork, it tore the whole of it away from the iron-plates; but, in the intended future trial, the place occupied by the brickwork will be filled up with earth. The result of the experiments proved, in the opinion of the military officials present, the perfect shelter men would have in working artillery behind a battery built on this plan.

The Royal Miners' Artillery Militia of Cornwall were recently inspected (by Col. Pester) at Truro. The efficiency of this regiment elicited great praise from the gallant Colonel.

Range and Velocity of Projectiles.—An instrument for measuring with the utmost accuracy the range of projectiles, and the velocity with which they are thrown, and invented by Professor Wheatstone, has lately been received at the Tower.

The Gun-Trade.—During the last financial year the Government ordered of private contractors 1335 pieces of iron ordnance, weighing in the aggregate 4800 tons. Of these guns, 312 were long 68-pounders; 460 10-inch guns for hollow shot; 300 long 32-pounders; 19 10-inch howitzers; 44 8-inch ditto; 200 10-inch guns; and 19 10-inch field-howitzers. Contract prices varied from 19*l.* to 21*l.* per ton; this year tenders have been sent out for about 100 iron guns of the different calibres mentioned above.

The Martello Towers, along the channel coast, from Dover to Hastings, have recently been manned by detachments of the second brigade of garrison-artillery, and several of these defences have been mounted with new siege-guns, forwarded from Woolwich Arsenal.

A Floating Marine-Engineers' College has been projected by Capt. Robinson, who, in his prospectus, proposes that it should be under Government inspection, and be devoted to the purposes of practical instruction in the science of marine-engineering.

Fortification of Inchkeith.—Measures are about to be taken by the War Office authorities for commencing a battery on Inchkeith, for the protection of the Firth of Forth; a step which the Government has determined upon in the confidence that the City of Edinburgh will produce a corps competent to man and work the guns. This has been officially notified from the War Office to the Edinburgh Chamber of Commerce, in reply to their recent memorial on the subject.

Capt. Grant's Pontoon Cooking Stoves.—An effectual trial of the new "Ambulatory Kitchens, &c., for Military Purposes," was made, 2nd August ult., on Dartford Heath, under the inspection of Major-Gen. Sir R. Dacres, and the principal officers of Woolwich Garrison. The whole of the disposable force of the Royal Artillery stationed at Woolwich were marched in two divisions to Dartford for that purpose. For the erection of the pontoon stoves, trenches were dug in the form of a cross, in which four pontoons were laid, served by an iron chimney, about two feet in height, easily adapted or removed. The fires were lighted in the trench at the four angles; the fuel, in this instance 200lbs. of wood, was packed on each side of the boiler, the heat of which assists in drying the wood, if green or wet. Weight of the apparatus, 13cwt. 11½lbs. Results of trial proved that 150lbs. of wood are sufficient to cook three daily meals for 500 men—the old Government allowance, being 3lbs. of wood per man a day. After the dinner was over the pontoons were formed into a raft, and their efficiency satisfactorily proved on a piece of water on the heath. In Hyde Park, on the 4th August ult., similar experiments were made in the presence of the Duke of Cambridge, General Commanding in Chief, with complete success. The novel mode of converting cooking utensils into pontoon rafts, or a bridge, by means of which an entire regiment or division might, in a time of emergency, pass over a river of considerable width, was the subject of particular interest. On this occasion two rafts were quickly formed with a number of cooking utensils, and thus crossed and recrossed the Serpentine, with four men on each raft, with the utmost ease. His Royal Highness expressed his satisfaction with the result of the experiments.

The Fortifications at Tynemouth (coast defences) are rapidly proceeding. Earth-works are being erected for the reception of heavy guns, both in the Castle-yard and at Clifford Fort. The walls surrounding the castle have been loopholed for the action of musketry in every supposed possible position likely to be required in defence of the entrance of the river.

Russian Rifled Cannon.—Late advices from St. Petersburg state that some rifled cannon have been cast at Toula, and that the operation has perfectly succeeded. All the artillery of the Guard, it is added, are likely to be supplied with rifled pieces before the end of the year, most of them cast in Russian foundries.

Photography in Warfare.—The War Department has lately made arrangements for forwarding photographic apparatus to every military station in the empire for the purpose of taking views of coast lines, fortifications, &c., for transmission to head quarters.

Rifled Cannon.—There are at present, it appears, no less than 7000 smooth-bored guns now lying at Woolwich Arsenal. It has been proposed to rifle, at all events, a part of these; the work, if necessary, being distributed among the various factories in our great towns.

Shot-proof Vessels, &c. — The *Undaunted*, sailing frigate, in the ship basin at Portsmouth, has workmen engaged upon her affixing the iron plates to her sides for fresh experimental practice.

French Rifled Cannon.—The Emperor has (15th August ult.) appointed Lieut. Fenile Debaulieu to the post of Director of the Factory of Arms of Precision, "on account of the principal part he has taken in the foundation of the new system of rifled cannon since 1849."

Shell Practice.—Fatal Accident.—An inquest was held, 5th August ult., on a lad, son to the coast guard who occupies No. 19 Tower, between which and No. 20, a distance of 400 yards, the target for artillery practice is placed. When practising, an officer is stationed under shelter of one of these towers for the twofold purpose of noticing the effect of the shell, and seeing that the range is clear. On this occasion, by some unfortunate miscalculation, the boy, who was under shelter of the other tower, and who was, consequently, considered quite safe, was killed by the explosion of the shell. Verdict—"Accidental death, from a piece of exploded shell fired by the Royal Artillery at practice."

Armstrong Rifled Ordnance Factory, Woolwich.—In order that this and other contract works at Woolwich may not be delayed through the building strike, or rather, masters' lock-out, the Royal Engineer Department in the Arsenal have adopted the precautionary measure of having an abundance of tools supplied from the Military Store Department, whilst a company of Royal Engineers, consisting of 120 competent artificers, under orders for the Mauritius, arrived at Woolwich, 8th August ult., from Brompton Barracks, and on the following day commenced their duties; so that the works, it is expected, will be completed by the time originally stipulated for (by the contractors, Messrs. Lucas Brothers), who continue to superintend the works as heretofore. Two other companies of Royal Engineers are under orders to join from Aldershott, so as to avert any delay anticipated from the strike in the Government (contract) works at Woolwich. The buildings are already (10th August) roofed in, and a large proportion of the machinery has arrived from Manchester and Scotland in readiness for fitment.

Marine Gunnery.—In order to counteract the disturbing effects of the rolling of a heavy steamer (much greater than that of a sailing ship of the same size), as regards accuracy of aim, steam men-of-war are now provided with heavy pendulums suspended amidships, the movements of which, the captains of guns, with trigger-line in hand, watch carefully, pulling the laniard only at the precise moment that the perpendicular position of the pendulum indicates that the vessel is on an even keel.

MINING.

A fatal Colliery Accident occurred, morning of 30th July ult., at High Heworth Colliery, by which two lives were lost. The master shifter and two men were employed in the shaft, suspended in the cage making some repairs, when a portion of the brattice gave way and came down upon them, breaking the chain of the cage and causing it to hang on one side. The two men were both precipitated into the pit, a depth of 200 yards, one of them coming into contact with the bunting, was cut completely in two, the other was found at the bottom of the pit headless. The master shifter had clutched hold of the chain, and hung there till he was rescued.

To the North of Port Augusta (South Australia), the recent discovery of extensive and valuable mineral deposits is announced.

The "Baby Nugget."—On the Kangaroo and Mount-Glasgow Gold-field (Amherst District, Australia), several large nuggets have recently been found, one of which, from a fancied resemblance to the human form, has been named the "Baby Nugget." It weighs 113 ounces.

At Commissioner's Hill the recent discoveries of gold have proved exceedingly valuable.

The London and Virginia Gold Mining Company held their annual meeting in London, 4th August ult. The accounts showed a loss of 5814*l.* on the mining operations of the Company since the commencement of the undertaking. The Company's property in Virginia had been advertised for sale (pursuant to the resolution to dissolve, of 19th August, 1858), in America and English papers, but no absolute purchase had been made.

From California, advices to the 27th July ult., state that rich discoveries of Gold have been made in the Coast Range Mountains, Humboldt County.

Coal in British Columbia (near Queensborough, the new capital) is announced as having been discovered in large quantities.

About 500 Pitmen belonging to Seaton Delaval Colliery, in Northumberland, recently struck work for an advance of 3*d.* a ton; their leaders were taken into custody, and, in anticipation of a disturbance, a strong detachment of county constabulary was sent down to the colliery. The men were under an agreement to work from month to month, and to give and take a month's notice before leaving their employment; but, because of a briskness in the steam coal trade, the men all struck without giving an hour's notice. Eight of the more active among them were committed two months each to gaol, 21st July ult., and four were taken into custody in the justice-room of North Shields, and remanded.

A Rock-drilling Machine has just been patented, in the United States, by Mr. L. White, of Davenport, Iowa, for rendering the drilling of rocks less laborious than it has hitherto been. By turning a crank, the drill receives a rapid percussive and return motion, giving three blows to one rotation of the crank; and at the same time, the drill is fed to its work, and itself turned to cut the hole round. A two-inch bore and under can be done by hand; and it is only above that size that animal or steam power will be required.

Coal in Bute.—The *Greenock Advertiser* states recently, that coal has been discovered at Ainbus Beg, about four miles west of Rothesay; it is suitable for most purposes, and is selling at Rothesay at 1*s*. 3*d*. per cwt. less than Glasgow coal.

Port Philip and Colonial Gold Mining Company. (Advices from Melbourne, 16th June ult.)—Quantity of quartz crushed during month of May, was 857 tons; 257 being crushed during the first, and 600 tons during the last fortnight. Amount received for crushing, &c., 2040*l*. 4*s*. 7*d*.; expenditure, 1511*l*. 8*s*. 1*d*.; profit, 528*l*. 16*s*. 6*d*.

The Clunes Company propose opening a mine to a further considerable extent, and are about to sink a new main-shaft to raise quartz from. The yield of gold was 922 oz. 14 dwts. to the 857 tons crushed during the month.

Mexican Mines.—Advices from Guanaxuato, to June 24th ult., are favourable. The mine of Jesus Maria y Jose (United Mexican Mining Association), sales produced in 5 weeks, 8128 dollars, and ore extracted by day-miners had been sold to the value of 1588 dollars; giving together, 5652 dollars to the credit of the mine. The naval commander at Vera Cruz has received instructions from the British Government to demand and enforce the restitution of the money taken from the Mint. The Company's mines had been in no way further molested.

The Gold Returns of Victoria show (according to the *Australian and New Zealand Gazette*), gold receipts, by escort, since the opening of the gold fields.—1851, 104,154oz.; 1852, 2,039,382oz.; 1853, 1,874,409oz.; 1854, 1,476,666oz.; 1855, 2,132,398oz. 1856, 2,625,968oz.; 1857, 2,481,020oz.; 1858, 2,371,268oz.; 1859, 817,411oz. Total quantity of gold brought to town, by escort, since the discovery of gold, 15,922,979oz. Total shipments of gold during the same period, 18,451,964oz., of which the following are the details:—Gold exported—1851, 145,146oz.; 1852, 1,974,975oz.; 1853, 2,497,723oz.; 1854, 2,144,699oz.; 1855, 2,576,745oz.; 1856, 3,003,811oz.; 1857, 2,729,355oz.; 1858, 2,536,793oz.; 1859, 842,222oz.

The Fitzroy Iron and Coal Mines, in the Colony of New South Wales (at Mattagong, which will shortly be within two or three hours of Sydney by rail), are officially reported to be likely to prove of great importance. The ore is pronounced to be equal, if not superior, to any now obtainable in England for all the finer operations of cutlery. Good coal exists on the spot, as also limestone, at a distance of two miles; so that the manufacture of iron may be conveniently carried out on the spot.

The Amount of Mining Property Assessed under the Income Tax (in England and Wales) is 3,485,150*l*., and Quarries, 366,801*l*.

The Cornwall Great Consolidated Lead and Copper Mining Company's General Meeting, which had been called for the 10th August ult., to confirm the winding-up of the undertaking, or transfer its interest to a new company, has been adjourned.

An Explosion of Fire-damp occurred, morning of the 13th August ult., at Colliery No. 8 of the Tredegar Works. Cause, the incautious use of a naked light by two of the miners, who went to work with a naked candle, passing that part of the pit where, on the day previous, there had been a fall, and where a quantity of explosive gas had consequently accumulated. Both the men dreadfully hurt, so much so, that their lives were despaired of.

METALLURGY.

British (Metal, &c.) Exports to Australia.—The returns from the Board of Trade for the half-year ending June 30th, 1859, under the head of Metals, Iron, Lead, Hardware, and Machinery, furnish a total of 650,628*l*.; on the general exports (collective amount, 3,252,315*l*.), there is, as compared with same period of last year (3,290,295*l*.), a decrease of 61,320*l*.

A Large Steam-hammer for the Elswick Rifled Ordnance Works has just been completed by Messrs. Morrison and Co., Ousebourn. It is called a 60 cwt. hammer. Dimensions—2 ft. 2½ in. diameter of cylinder; length of stroke, 4 ft. 6 in.; diameter of bar, 12 in., and length, 15 ft. 6 in., in one solid piece with the piston; height, under frame, 7 ft. 8 in.; width between frames, 12 ft.

The Total Assessment of Ironworks to the Income Tax (in England and Wales) is 1,249,531*l*.

Bell-founding.—The hour-bell for the clock-tower of the Town-hall, Leeds, has been cast by Messrs. Warner. Its diameter is 6 feet 3 inches; weight, about 4½ tons; it is spoken of as being an excellent piece of casting.

APPLIED CHEMISTRY.

For Deodorizing the River Thames, Dr. McGregor Croft proposes, by aid of the river-steamers, to purify the water by means of the Liquor Sodæ Chlorinatæ, well known as a powerful deodorizer. Each vessel to carry a zinc tank capable of holding a hogshead of this liquid, and a pipe from the tank is to empty the contents (regulated) beneath the sterns. The constant revolution of the paddle-wheels would effectually mix the fluid with the sewage. The inventor asserts that he could in 48 hours remove by this process all stench from the river.

Photographic Engraving in Relief.—M. Berchtold has succeeded in engraving, by the action of light on a zinc plate, the copy of a bust of the French Empress, by Nieuwerkerke, which plate has been printed from as easily as from an ordinary wood-cut.

Light.—Tartaric Acid, like nitrate of uranium, is found to have the property of retaining light in its condition of chemical efficacy.

For giving a "Velvet-black" (noir-de-velours) Coating to Zinc Plates, M. Boettger, of Francfort, dissolves 2 parts, by weight, of nitrate of copper, and 3 parts of "chlorure cristallisé" (chloride of copper, we presume, is here meant), in 64 parts of distilled water, adding 8 parts hydrochloric acid, s. g. 1·1. Into this liquid he dips the zinc plates, previously well scoured with fine sand. The metal, after this immersion, is to be well washed in water, and dried rapidly. M. Boettger adds, that by writing with this composition on a zinc plate, and then using weak nitric acid (diluted to 1-10th of its strength) characters in relief may be obtained; the black skin resisting like a varnish the action of the acid.

Fire-proof Composition.—The Admiralty, we understand, have recently instituted a series of experiments, conducted by Messrs. Abel and Hay, to test the efficacy of soluble glass in rendering timber incombustible. The wood is thus prepared. Two or three slight coats of the solution are first given—viz., 1 part by volume of the thick solution of silicate of soda with 3 parts water; this is readily imbibed by the pores of the wood. When nearly dry, a coating of lime (cream of lime), is next given; this, when nearly dry, is fixed by a more concentrated solution of glass—viz., 2 volumes of the thick solution to 3 of water. The result of the experiments showed that timber (or wood-work) thus prepared, offered great resistance to the action both of heat and flame; that the coating does not peel off from the surface, even under violent heat; that the composition prevents the wood bursting into flame for a considerable time, even when exposed to a charring heat; and that it almost completely resists the action of flame playing round the surface. Rain has no effect whatever on timber thus protected; a strong jet of water directed upon it for a considerable time did not disturb or wash off the fire-proof coating; violent blows on the wood did not cause it to scale off, excepting at parts where the lime had been painted on too thickly. About 2 pounds of soluble glass sufficed to render fire-proof a surface of about 7 square feet.

Sericine.—By recent experiments, M. Schlossberger has ascertained the chemical identity of silk and the spider's web. He proposes to call their immediate principle Sericine, from Serica, silk.

Adulteration of Vinegar by Sulphuric Acid.—To detect this by no means unfrequent and dangerous fraud, mix a small quantity of starch with the suspected vinegar, and let it boil for 20 or 30 minutes. The action of the sulphuric acid, as is well known, is to convert the starch into fecula; but acetic acid, as M. Payen proved, has not this property. Hence it follows, that if the vinegar be pure, and not contaminated with a mineral acid, the starch will retain all its usual characteristics, and will, when left to get cold, produce, on addition being made to the liquor of a small quantity of iodine, a beautiful blue: should no colour appear, it is because the starch has been saccharized, or converted into sugar, by the presence of free sulphuric acid in the vinegar. For this test, the iodide of potassium ought not to be substituted for the free iodine; for with the iodide, as happened in a recent case of testing some suspected vinegar, the blue colour may not make its appearance, notwithstanding the presence of the starch. Another method of detecting the presence of free sulphuric acid is, to concentrate the vinegar, and to evaporate it to dryness, in a sand-bath, or simply on a piece of paper of good quality (such for instance as will, on burning, leave but few ashes). The sulphuric acid, in concentrating, hastens the carbonization of the paper, and produces a black spot, a sure indication of the presence of free mineral acid in the liquid experimented upon.

To Detect Adulterating Substances in Beer, such as lead, copper, calcareous salts, tartaric acid, strychnine, bucina, henbane, cocculus indicus, &c., &c., a few simple chemical tests easily applied will suffice. The copper, for instance, may be discovered by evaporating the beer to the consistency of an extract; incinerating the latter, and treating it with dilute nitric acid, which will assume a bluish colour and become darker by the addition of ammonia.* If a piece of iron scoured with dilute sulphuric acid be then introduced into the solution, the former will be precipitated upon it in a metallic state. The presence of lead will be made evident by sulphate of soda, which produces a white precipitate;† oxalate of ammonia will effect a similar precipitate if the liquid contain calcareous salts; tartaric acid may be detected by a solution of potash poured on the extract, re-dissolved in water, which will give a granular precipitate. To detect the (by no means unusual) substitution in beer of various narcotic and other ingredients for hops, is somewhat more difficult; many of these, nevertheless, may be easily recognized. These latter, colouring or intoxicating drugs, consist (usually) of the leaves of the box-tree, of the menyanthes, various kinds of mint, the flowers of the linden-tree, gentian (but rarely), poppyheads, guaiacum or lignum vitæ, Spanish juice, henbane, grains-of-paradise, cocculus indicus, cayenne pepper, nux vomica, and a powder composed of sulphate of copper, persulphate of iron, fecula, and some extract or other of a bitter and astringent nature. The nux vomica, and other drugs of the strychnos genus, all more or less stupifying, tetanus-producing, or otherwise deleterious, may easily be detected by reducing the beer to an extract, as above directed, and then treating it by alcohol; the latter dissolves the strychnine and brucine. The vegetable basis of the family of the strychneæ, and their nature, may be tested by sulphuric acid and bichromate of potassia.

For Amalgamating Battery Plates by simple Immersion, M. Berjot's new process is to dissolve with heat 200 grammes of mercury in 1000 grammes of nitro-chloric acid (nitric acid, hydrochloric acid 3 parts), adding, when the mercury is all dissolved, 1000 grammes of nitro-chloric acid. Immersion for a few seconds in this liquid will suffice to amalgamate most completely the zinc plate, however roughened by corrosion.

Photography—Collodion Process.—Amongst the lately granted pensions (on the Civil List pursuant to Act 1 Victoria, c. 2), is one of 50*l*. to the three daughters of the late Mr. Archer, "in consideration of the valuable contributions of their late father to the science of Photography."

* With the yellow cyanide of potassium, or the cyanurets, the precipitate is of a reddish brown.

† M. Hureaux recommends as an additional test for the presence of lead, the iodide of potassium, which will give a yellow precipitate, as will also the chromate of potass; with a current of sulphuretted hydrogen, a muddy black cloud will appear.

LIST OF NEW PATENTS.

APPLICATION FOR PATENTS AND PROTECTION ALLOWED.

Dated 27th May, 1859.

1310. L. D. Jackson, 32, Finsbury Market, Finsbury—Machine for cutting wood.

Dated 21st June, 1859.

1495. W. Coles Fuller, 2, Bucklersbury, Cheapside—India-rubber shackles.

Dated 22nd June, 1859.

1498. W. Buckwell, Phœnix Stone Works, East Greenwich—Manufacturing materials for building and other structural purposes.

Dated 23rd June, 1859.

1507. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Machinery for the manufacture of bolts and rivets.

1510. A. J. Dessales, 13, Rue des Enfants Rouges, Paris—Working and securing of sliding tubes, applicable to gas chandeliers, lamps, and other purposes.

1512. G. C. Grimes, Wandsworth, Surrey—Cigar lights.

Dated 28th June, 1859.

1538. G. Dawes, Milton Iron Works, Hoyland, York, and C. J. Carr, Hoyland—Atmospheric and vacuum hammers and stamps.

Dated 29th June, 1859.

1546. T. Wright, Middlesborough-on-Tees, Yorkshire—Apparatus used in the manufacture of cast metal pipes and castings, termed core bars or spindles and chaplets.

Dated 30th June, 1859.

1554. A. Gueyton, Paris—Enamelling articles of jewellery.

1560. J. Lawson and S. Cotton, Leeds—Machinery for roving, twisting, and spinning flax.

Dated 5th July, 1859.

1595. C. Barlow, 89, Chancery-lane—Capstans.

1596. A. Beaulieu, 25, Rue du Chemin de Fer, Porte de Cologne, Brussels—Crinolines.

1598. J. H. Nalder, Alvescott, Oxfordshire, and T. Nalder, Challow Works, Berkshire—Winnowing and dressing grain and seeds.

Dated 6th July, 1859.

1600. W. H. Ward, Auburn, Cayuga, U.S.—Ocean marine signal telegraphing for day and night, whereby messages and communications on all occasions and subjects may be given with clearness and dispatch, within seeing distance, day or night.

1602. J. Luis, 1b, Welbeck-street, Cavendish-square—Manufacture of wheel wires for railway carriages and engines.

1604. C. Hagan, Tower of London—Apparatus for curing smoky chimneys.

1606. S. Lloyd, Wednesbury, Staffordshire—Manufacture of cast steel tyres.

1608. B. Seed, Keighley, and T. Steel, Bradford—Apparatus employed in the treatment of soapsuds or other saponaceous or oily matters.

Dated 7th July, 1859.

1610. D. T. Jones, Headless Cross, Ipsley, Warwickshire—Ploughs.

1611. C. F. Vasserot, 45, Essex-street, Strand—An im-

proved form of regulator, chiefly applicable to water wheels.
1612. F. A. Le Mat, New Orleans, U.S.—Imp. applicable to ordnance.
1614. R. C. Rapier, Newcastle-upon-Tyne—Working rolls for rolling plates of unequal thicknesses.
1616. J. Smith, Norton-street, Cherry-square, New Radford, Nottingham—Propelling ships.
1618. J. H. Johnson, 47, Lincoln's-inn-fields—Knitting-frames.

Dated 8th July, 1859.

1619. G. Ellis, 4, Collier-street, Pentonville—The imp. of muffs, to be called "the patent reticule travelling muff."
1620. W. H. Dawes, Bromford Iron Works, West Bromwich, Staffordshire—Manufacture of iron.
1622. F. A. Le Mat, New Orleans, U.S.—Construction of revolving or repeating fire-arms.
1623. J. Gibbs, Brentford, Middlesex—Manufacture of brushes, brooms, and coverings for floors.
1624. G. Cartwright, Birmingham—Corks for bottles and jars.
1625. G. A. Boggis, Croxted-place, Dulwich, Surrey—Rendering boots and shoes waterproof.
1626. E. Livermore, New York, U.S.—Manufacture of burning fluids for illuminating and heating purposes.
1627. D. Mathews, Eshald Well Brewery, Oulton, near Leeds—Apparatus for refrigerating and heating liquids.
1628. J. H. Johnson, 47, Lincoln's-inn-fields—Moulding or shaping metals by pressure.
1629. W. H. Harfield, Fenchurch-street—Ships' capstans and riding bits.
1630. H. Brinsmead and J. Lawrence, Ipswich—Rotary screens.
1631. J. Taylor, Roupell-park, Streatham-hill, Surrey—Construction of walls to prevent damp from rising.
1632. T. D. Duppa, Longville, Winstanton, Shropshire—Carpenters' benches.
1633. W. Woof, Gloucester—Ploughs.
1634. W. N. Nicholson, Newark-on-Trent—Machines for making and collecting hay, and for cutting thistles and weeds.
1635. W. N. Nicholson, Newark-on-Trent—Clod crushers and land and garden rollers.

Dated 9th July, 1859.

1636. M. Henry, 84, Fleet-street—Manufacture of overshoes and other articles worn on the feet.
1637. B. Samuelson and J. Shaw, Britannia Works, Banbury—Reaping and mowing machines.
1638. F. Ayckbourn, 27, Henry-street, Vauxhall-gardens, Surrey—Constructing certain articles of dress, so as to prevent drowning.
1639. C. Iliffe, Birmingham—Manufacture of buttons.
1640. W. Mac Kean, Paisley, Renfrew, Scotland—Manufacture of farinaceous matters for the obtainment of starch and food.
1641. E. Livermore, New York, U.S.—Generating gas for the purpose of lighting and heating.
1642. J. Smith, Bradford, Yorkshire—Apparatus for heating and cooling water.

Dated 11th July, 1859.

1643. E. F. Hutchins, Albert-cottages, Perry-street, Northfleet, Kent—Constructing the jaw or jaws of vices, and holding tools in general with a ball and socket joint.
1644. R. Clegg, Islington—Machines for cutting wood and metal.
1645. H. Davies, 13, Leicester-buildings, King-street, Liverpool—Manufacture of soap.
1646. J. C. Pickard, Burnley, Lancashire—Weft forks for looms.
1647. W. E. Newton, 66, Chancery-lane—Magneto-electric machines.
1648. J. Dible, Northam, Hants, and W. H. Graveley, Upper East Smithfield—Apparatuses for ventilating and lighting ships.
1649. F. Burden, John-street, Adelphi—Permanent way of railways.
1650. J. A. Hartmann, Mulhouse, France—Manufacture of colours for printing cotton and other vegetable fibres and silk.

Dated 12th July, 1859.

1651. J. Luis, 1B, Welbeck-street, Cavendish-square—Imitation leather.
1652. J. Luis, 1B, Welbeck-street, Cavendish-square—Railway car seats and arm chairs.
1653. C. J. Proal, 4, South-street, Finsbury—The application of photographic impressions or pictures upon fabrics or tissues, for rendering such fabrics or tissues applicable to various useful purposes.
1655. W. White, Mansfield, Nottingham—Apparatus for counteracting the effects of collisions in railway trains.

Dated 13th July, 1859.

1657. C. S. Walker and R. Hoyle, Bury—Apparatus for promoting the consumption of smoke in steam boiler and other furnaces.
1658. A. Cooper, Birmingham—Manufacture of the grips of swords and sword bayonets.
1659. J. S. Thomson, Kilmarnock, Ayr, N.B.—Steam engines.
1660. W. Cotton, Loughborough, Leicestershire—Apparatus for connecting together or uniting looped fabrics.
1661. J. Combe, Belfast—Machinery for hackling flax.
1662. J. Taylor, Roupell-park, Streatham-hill, Surrey—Stoves and fire-places.

Dated 14th July, 1859.

1663. W. Walker, Liverpool—Manufacture of metallic packages.
1664. R. Mushet, Coleford, Gloucestershire—Manufacture of shot and shell.
1665. R. Mushet, Coleford, Gloucestershire—Manufacture of certain metallic compounds or alloys.
1666. J. Atkinson, Lancaster—Firearms.
1667. J. H. Johnson, 47, Lincoln's-inn-fields—Manufacture of artificial fuel.
1668. J. Morgan, Manchester—Apparatus for making candles.
1669. J. Bailey, Manchester—Apparatus for stretching woven fabrics.
1670. R. Longstaff, Mornington-road, New Cross, and A. Pullan, Fortie-cottage, New Cross—Traction or locomotive engines.

Dated 15th July, 1859.

1671. C. Kingsford, Seaton, near Wingham, Kent—Preparation of peat and charcoal for fuel.
1672. W. Clark and W. Williams, Manchester—Finishing woven fabrics.
1673. F. Brown, City Road, Middlesex—Manufacture of a new fibrous pulp for making paper.
1674. R. Mushet, Coleford, Gloucestershire—Methods of manufacturing a certain metallic compound or alloy.
1675. H. Grand de Chateauneuf, Paris, France—An improved coverlet called zephir-eider-down coverlet.
1676. J. P. Farrar, New York—Treatment of iron.
1677. W. McAndrew, 57, King William-street, London, and C. W. Boyd, Sochia, Asia Minor—Treating poppies to obtain a product resembling opium therefrom.
1678. W. O. Carter, 12, South John-street, Liverpool—Machinery for sawing slate.
1679. F. Prince, 138, New Bond-street, Middlesex—Breech loading firearms.

Dated 16th July, 1859.

1680. J. Musgrave, Jun., Bolton-le-Moors, Lancashire—Construction of steam-boilers.
1681. J. Bernard, Albany, Piccadilly, Middlesex—Construction and arrangement of hydraulic and other pumps for forcing liquids.
1682. J. Bernard, Albany, Piccadilly—Manufacture of boots and shoes.
1683. C. Pottinger, Anstruther, Fife, N.B.—Apparatus for dredging or excavating, and for driving piles.
1684. H. Cunnew, Triangle, Hackney, Middlesex—Elastic bands.
1685. P. A. A. Trouttet, Dijon, France—A new moveable stopper for gaseous liquids.
1686. O. Grimshaw, Belfast—Safety letter boxes or bags.
1687. W. M. Smith, Northampton—The construction of fare-boxes, for the prevention of fraud on the part of drivers, conductors, &c.
1688. M. H. Chapin, Boston, U.S.—Manufacture of galloons, tapes, or ribbons for supporting steel or other hoops used for distending ladies' dresses.
1689. T. Carliell, Union-street, Portsea—Vent-pegs.

Dated 18th July, 1859.

1691. J. Bernard, Albany, Piccadilly, Middlesex—Manufacture of boots and shoes.
1692. H. C. M. Cramer, Paris—Bedsteads.
1693. J. Shaw, Teignmouth—Manufacture of artificial fuel.
1694. A. Phillips, Glasgow—Weaving carpets.
1695. W. H. Harfield, Fenchurch-street—Apparatus employed in getting ships' anchors and in shackling chains.
1696. W. E. Newton, 66, Chancery-lane—Method of constructing and operating batteries for generating or exciting, by chemical action, electricity for telegraphic purposes.
1697. A. V. Newton, 66, Chancery-lane—Manufacture of India-rubber, and other like fabrics.

Dated 19th July, 1859.

1698. J. Luis, 1B, Welbeck-street, Cavendish-square—A new system of eccentric socket adapted to axle-trees.
1699. F. C. Bakewell, 6, Haverstock-terrace, Hampstead—Extracting oils from coal and other minerals.
1700. J. Shanks, of Arbroath, Forfar, N.B.—Mowing machines.
1701. H. Parent, Roubaix, France—Looms for weaving.
1702. J. C. Riddell, Belfast—Enclosures for horses, cows and other animals.

Dated 20th July, 1859.

1703. J. Erskine, Newton Stewart, N.B.—Breech-loading firearms.
1704. T. Curtis and J. Haigh, Leeds—Finishing of cloths.
1705. W. E. Gedge, Wellington-street South, Strand—Improved apparatus for the prevention of accidents in mines, to be called a mining parachute.
1706. W. J. and D. Gradwell, Manchester—Bearings of railway wheels.
1707. Right Hon. J. Earl of Caithness, Hill-street, Middlesex—Permanent way of railways.
1709. W. E. Newton, 66, Chancery-lane—Self-acting lithographic printing machines.

Dated 21st July, 1859.

1711. J. Todd, Castlemains, Haddington—Apparatus for dressing grains and seeds.
1712. G. Welch, Birmingham—Manufacture of frames for mirrors, pictures, and other articles.
1713. I. Robson, Dalton, near Huddersfield—Apparatus for drying and cutting cotton warps after being dyed or sized.
1714. C. Tapp and J. B. Tapp, Chesterfield, Derbyshire—Economising fuel in the generation of steam.
1715. M. Henry, 84, Fleet-street—Machinery for the manufacture of corks and bungs.
1716. E. J. Scott and S. F. Scott, Glasgow—Manufacture of boots and shoes.
1717. H. Healey, Ashby Decoy Cottage, near Brigg, Lincolnshire—Machinery in destroying flies and other insects on growing crops.

Dated 22nd July, 1859.

1718. J. Hartley, Romiley, near Stockport—Machinery for regulating the velocity of steam and other engines.
1719. J. G. Isham and S. D. Albertson, New York—An improved machine for cutting and shaping bottle and other corks.
1720. S. A. Bell and J. Black, Bow-lane, Cheapside—An improved manufacture of fusees.
1721. W. E. Newton, 66, Chancery-lane—Sewing machines.

Dated 23rd July, 1859.

1722. J. B. Whitehall, Nottingham, and S. Wheatcroft, New North-road, Middlesex—Manufacturing bonnet and cap fronts.
1723. H. N. Harrop, jun., Manchester—Cigar lighter and fusee box.
1724. J. Broadley, Saltaire, Yorkshire—Apparatus used in weaving.
1725. J. Tenwick, Clarendon-street, Portsmouth—Steering apparatus for ships.
1726. W. H. Harfield, Fenchurch-street—Capstans, riding-bits, and stoppers for working with chains.

Dated 25th July, 1859.

1727. H. Ambler, Halifax—Explosive projectiles.
1728. J. Rowland, jun., and George Hall, Oldham—Apparatus for sizing yarns or threads.
1729. G. Davies, 1, Serle-street, Lincoln's-inn—Dyeing yarns, threads, or woven fabrics of wool, silk, cotton, linen, or other fibrous or filamentous material.
1730 E. Hunt, Glasgow—Apparatus for indicating and regulating speed.
1731. W. E. Newton, 66, Chancery-lane—Extracting oil from coal and other substances yielding pyrogenous oils.
1732. C. F. Vasserot, 45, Essex-street, Strand—Preventing and removing incrustations in steam-boilers.

Dated 26th July, 1859.

1733. J. King, Glasgow—Treatment of materials used in or resulting from the distillation of spirits.
1734. W. H. Buckland, Maesteg Iron Works, Glamorganshire—Preparation of peat.
1735. J. H. Johnson, 47 Lincoln's inn-fields—Slide valves for steam-engines.
1736. P. D. Mickles, Syracuse, New York, U.S.—Spring for railroad and other carriages.
1737. J. Hinks and G. Wells, Birmingham—Hook and eye dress fastening.
1738. J. Gillott and J. Morrison, Birmingham—Machinery for the manufacture of the handles of penholders.

Dated 27th July, 1859.

1740. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—An improved comb-cleaner.
1741. E. Winstanley, Ashton-under-Lyne—Indicators for registering the quantity produced by spinning machinery.
1742. J. Davies, Tetbury, Gloucestershire—Improved self-adjusting ventilating apparatus.
1743. T. Dickens, Middleton, Lancashire—Dyeing and discharging warps or other yarns or threads.
1744. J. Scoffern, 4, Barnard's Inn, Middlesex—Waterproofing, cementing, and stiffening fabrics and fibrous materials.
1745. C. L. Blum, 29, Boulevard St. Martin, Paris—A mechanical apparatus for smoking and colouring pipes.

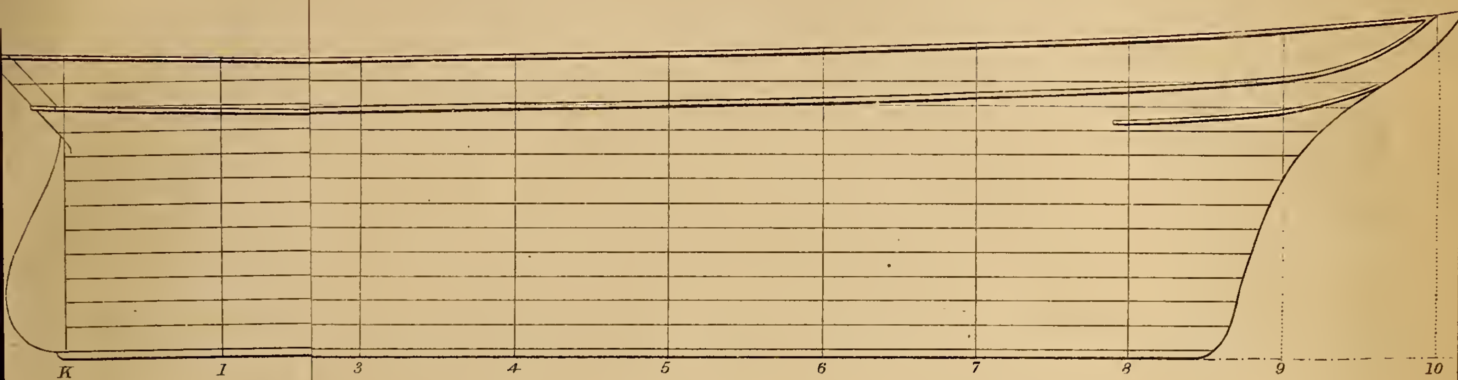
Dated 28th July, 1859.

1746. W. Hudson and C. Catlow, Burnley, Lancashire—Looms for weaving.
1747. E. Hunt and H. D. Pochin, Salford—Improved resin and resinous substances.
1748. A. Sidebottom, Crown-street, Camberwell, Surrey—Process of separating animal fibre from mixed fabrics of animal fibre.
1749. C. W. Smith, Evans, New York—Electric telegraphs.
1750. W. Kent, Paternoster-row—A self-acting fan.
1751. J. W. D. Brown, Lewisham, Kent—Signal and light-house lamps and lanterns.
1753. W. E. Newton, 66, Chancery-lane—Grinding-mills.
1754. W. Clark, 53, Chancery-lane—Improved apparatus for turning over music leaves or sheets.
1755. J. Jackson, Church-street, Spitalfields—Metal pens.
1756. P. Robertson, Sun-court, Cornhill—Manufacture of beer, ale, porter, and spirits.

Dated 29th July, 1859.

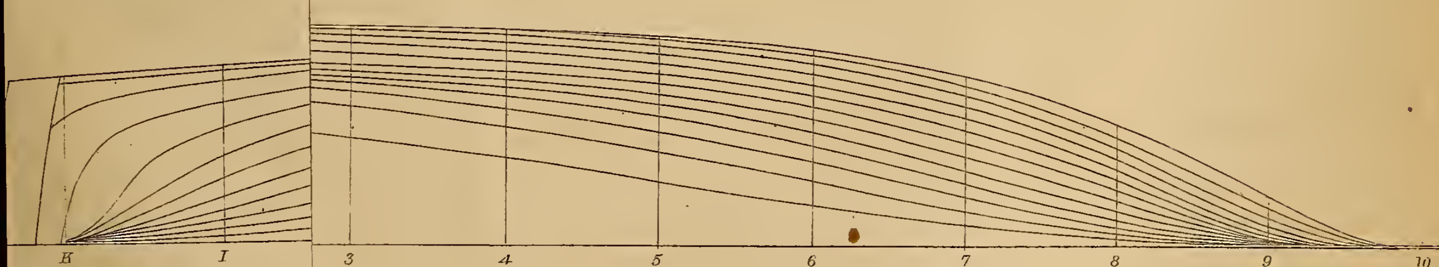
1757. T. Culpin, 25, Royal Hill, Greenwich—Water-closets, water-cisterns, lavatories, and other sanitary apparatus, and the mode of supplying water thereto.
1758. I. M. Lindley, Staleybridge, Chester—Cop-tubes.
1759. J. Wright, 42, Bridge-street, Blackfriars—An improved method of raising or drawing up the skirts of gowns or dresses.
1761. P. A. Viette, 25, Faubourg de Shaerbeck, near Brussels—Engraving on metal or other substances decomposable by acids or corrosive salts.
1762. J. Chandler, Deptford—Indicating the water level in boilers, also applicable for inspecting the interior thereof.
1763. T. J. Terrell, Poplar—Ships, riding bits, and timber heads.

EAM SHIPS



eam .... 30 F

old .... 25 Feet



Smith, CE direx.

LINES OF THE PACIFIC STEAM NAVIGATION COMPY.S STEAM SHIPS

"LIMA" AND "BOGOTA"

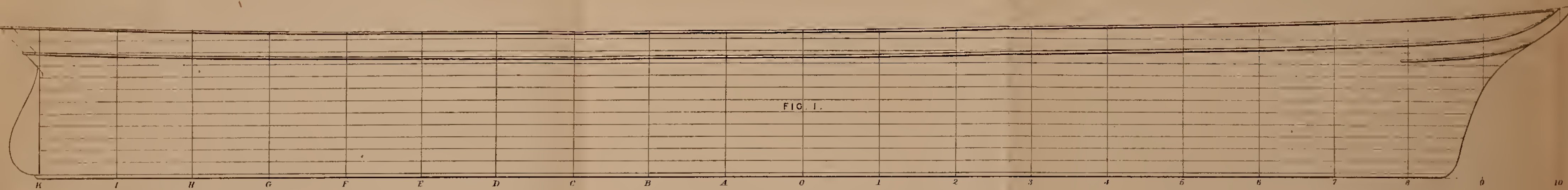


FIG. 1.

Total Length ...	[illegible] Feet	Width of Beam	30 Feet
Length of Keel ...	244 Feet	Depth of Hold	[illegible]5 Feet

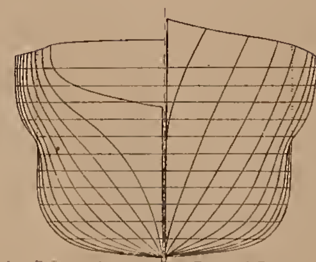


FIG 3

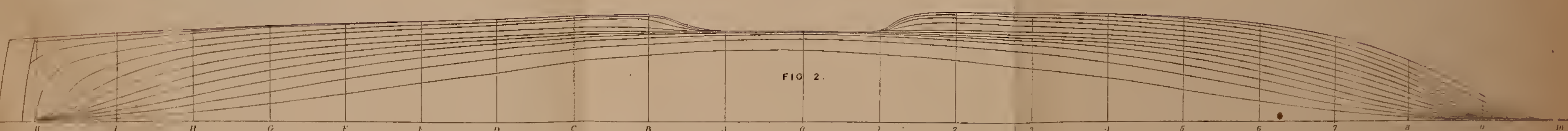


FIG 2.

THE ARTIZAN.

No. 201.—Vol. 17.—OCTOBER 1st., 1859.

STEAM ENGINEERING IN 1859.

THE MECHANISM OF THE STEAM ENGINE.

In all machinery there are two distinctive classes of defects in construction. There are those which are so palpable as to bring discredit to the designer; and there are those which, although in certain existence, may pass unnoticed and uncared for during the life of a machine.

In the first class may be included, want of strength, bad materials, bad workmanship, and deficient knowledge in the expanding and contracting powers of materials; in the second class, we find chiefly want af adaptation, complication, want of simplicity, errors of principle, and needless difficulties of access for examinations, repairs, and renewals.

We propose to say a few words on each of these classes of defects in steam machinery.

The engineering profession is indebted to the experiments of such eminent men as Fairbairn, Barlow, and others, for a practical knowledge of the strength of those materials used in the construction of a steam-engine, and this knowledge is so easily accessible that ignorance is inexcusable.

Constructive proficiency is obtainable in two ways: by experience, and by a careful study of the properties of materials. Many engineers depend almost wholly upon the former, few trust entirely to the latter; it is only when the two are combined, it deserves the title of engineering.

In old-established firms, where the same class of machine has been constructed for forty or fifty years, a degree of perfection is attained, difficult to be found in new establishments, although the manager may be most competent. There are exceptions to this general statement, and we might, perhaps, instance as one, the hydraulic machinery of Sir W. Armstrong, where there has been almost undisturbed success and comparatively no failures with a new establishment, and a new class of machinery. We believe we can trace the cause of this success, but we do not feel at liberty to allude to the management in detail of any private establishment.

One strange anomaly in the manufacture of steam-engines is the abominable specimens often found driving the tools of the firms who advertise to snpply steam-engines on the most improved principles. This is more the case in the North and Wales than in the South. Yon enter a large fitting shop, and hear in one corner a wheezing, grinding noise, which upon examination proves to be a "Pre-Adamite" steam-engine, dirty, leaky, and most extravagant in fuel.

How is it that, with such an extended experience, amounting to nearly 100 years, we have yet at the present time frequent break-downs and mishaps with our steam machinery? Surely, as such admirers of "precedents," we ought to be exempt from the mishaps of our Transatlantic friends, who do not hesitate to throw "precedent" overboard.

We believe the chief cause of our failures is the exclusive spirit existing among our manufacturing engineers, and although this exclusiveness tends to develope in competition, individual excellence and talent, it undoubtedly fosters positive ignorance,and contempt for the improvements of others.

We could positively fill pages with particulars of constructive failures, not of small people, but of engineers employing from 400 to 800 men, and we refer chiefly in these remarks to marine engieenrs.

With land and locomotive engines there are frequent opportunities for the manufacturer to observe defects in daily regular work, bnt in marine engines it frequently happens the designer has had little or no experience at sea, and unlike the Cornish man, he is too proud to "ax what he do'ant know." Hence it is we find patentees abounding who profess to supply us with engines so compact that they remind one mostly of those turned Chinese balls, one inside the other; but how they were put together, or how they can be separated, are questions difficult to solve.

It has been our misfortune, or, more correctly, *good* fortune, to be at sea in very bad weather, with new machinery, and we therefore can speak with certainty of the inconviences—not to mention danger—of defective construction; too much or too little taper in cocks, soft brasses, slack nuts, inaccessible valves, accessible passages for dirt or coal, and imperfect joints, &c.

Beam-engines for land or sea have had their day; they have been most efficient, and possess advantages not to be denied; but with the necessity for less weight, fewness of parts, and increased speed, they cannot compete with the oscillating, trunk, and other direct-acting engines.

For land purposes the horizontal engine, with long stroke and connecting rod, will multiply, on account of its small cost and simplicity.

For steam navigation simplicity is a great desideratum, perhaps we might say as to mechanical construction, it is *the* great desideratum. Compactness is all very well, if it means not an unnecessary waste of room, but compared with efficiency or economy it is not to be considered. A ton of coal saved will give 40 cubic feet additional space for machinery, and it will be found that space is economised not by extreme compactness, which generally induces neglect in maintenance, but by efficiency and economy of fuel; and it is highly satisfactory to know that, in adopting economical principles of construction, the economy attained is not confined to a mere saving of fuel, but of space, and we believe of capital also.

If it is possible to obtain 100 per cent more power from one ton of coal, there is every reason to believe such increased power can be secured without a corresponding increase in the first cost of the machinery.

These remarks bring us to a subject we wish to impress upon our readers, namely, the dimensions of cylinder and speed of piston.

A large cylinder and a short stroke are synonomous with waste of fuel, and yet large cylinders and short strokes prevail; indeed, in many cases the stroke does not exceed half the diameter of the cylinder. That such engines can realise the benefits to be derived from expansive action is almost impossible, whilst the amount of surface exposed for premature condensation is nearly a maximum.

We are quite alive to the importance of direct-acting screw-engines, running at a high speed, to insure a minimum amount of slip, and the length of stroke is regulated by what is considered a safe speed of piston; and there is reason to fear all efforts to decrease the diameter, and increase the length of steam cylinders, must be very limited, as long as the steam pressure is only 20 or 25 lbs. per inch, and the air-pumps attached to the main engines. With higher pressure the diameter can be reduced, and with separate air-pump engines the number of revolutions and speed of piston can be safely increased.

To ensure lightness in engine power, a maximum speed of piston is indispensable, and it may be taken for granted, that from 350 to 500 feet per minute, will be generally adopted for marine engines in a few years. If the speed of an engine is increased 50 per cent., the mean pressure remaining the same, an increase of 50 per cent of power is thus obtained without any additional outlay of capital, except what is required to give the increased quantity of steam, and it is well known the cost of boilers is only about one-third of that of the engines to which they are attached.

Increased pressure and increased speed of piston, we reiterate, are among the chief mainstays of future progress in steam power on land and sea.

As a natural consequence of an increased speed of piston, spur wheels, loose cranks, beams, levers, and all needless complications, must be dispensed with, steam must be applied direct to the resistance, and instead of *one* vast unwieldly machine, we must increase the number and decrease the size.

Mechanical lubrication is not sufficiently attended to in fast moving engines; by self-acting lubrication heating is avoided, and oil saved, and yet, in our mercantile steam navy, how few screw-engines are fitted with self-acting lubricators.

Land-engines are hardly considered complete without governors for regulating their speed; whilst marine-engines, with an ever varying load in a sea way, are only preserved from actual break-downs, by the constant attention of the engineer in charge—room again for improvement.

With reference to the *evils* of what is called a *compact* engine, we remember a case in which a pair of engines were put on board a ship, so compact, that after running a short time they were removed, simply because no engineer could be found willing to risk his arms and fingers in keeping them in order; and, in a less degree, this is a state of things not at all uncommon at the present day.

There are various details worthy attention and capable of great improvement, such as increased wearing surfaces, and the position of thrust-bearing, the latter too often forming a portion of engine framing, so as to throw crank pins, connecting rods, &c., out of truth, as the thrust-bearing wears.

And what shall we say about screw-propellers? Who knows anything definite about them, except captains and masters of steam-ships? They are the gentlemen to explain, with the greatest clearness, the precise action of the screw; the only misfortune is, that no two of these gentlemen agree.

We are inclined to the opinion that, if the present amount of experience in the diameter, pitch, and shape of screw-propellers was appreciated and applied, we could greatly increase their preseut duty.

One fact is proved beyond all doubt, that it is not advisable to have the pitch of a propeller more than 50 per cent in excess of the diamcter. The principles of construction included in what is called Griffiths' screw, are undoubtedly nearer the truth than any other; and there is a general tendency among engineers to adopt those principles, as far as they can, without actually infringing Mr. Griffiths' patents; but still the bulk of our marine engineers adhere to precedent too firmly to profit by the general experience, and we have in existence a collection of propellers onlp suitable for a museum of antiquities.

Supposing we have a good pair of engines, how do we place them in the ship? in a clean space by themselves—oh, no! *in the stoke hole.* Yes, hundreds of screw-engines from 70 to 200 h. p. are working in the stoke-hole, placed there, we presume, to receive all the dust and dirt, to act as emery powder on the bearings, and to prevent the possibility of the engineers in charge, keeping the machinery clean—*another advantage (?)* of this arrangement is the passage of cold air from the engine-skylight over and round the cylinders (in inverted engines) before it reaches the ash-pits and stoke-hole.

On land, generally, the engine is placed by itself as it ought to be, but at sea, when repairs are more difficult and costly, grit and dirt are positively encouraged.

It rests with engineers themselves whether they are to have sufficient room on board ship, to place their engines so as to ensure easy access for repairs, and perfect separation from the stokehole. Steamship owners oppose their own interests, by refusing proper space for machinery, and lose in economy and efficiency to an unknown extent.

We purposely avoid expressing any opinion on the several varieties of direct acting engines now in use, each has its advantages and disadvantages, but there can be no doubt a preference should be shown to a long stroke and a long connecting rod. Trunk engines are compact, but they expose a large surface for premature condensation. Oscillating engines are objectionable in many instances, on account of the difficulty of obtaining a simple and effective expansion gear; but faults of detail in the mechanism, sink into comparative unimportance, in comparison with the faults we have alluded to in the "generation of steam" and its "application as a motive power."

Much latitude may be allowed in the position and disposition of cylinders, rods, levers, &c., but *no* latitude can be allowed in the application of correct principles of economy, in the construction of steam machinery; it is in this latter respect we are so very remiss, and whilst we have one hundred plans for some trifling and almost unimportant alteration of mechanism detail, we are sadly wanting in practical suggestions for solid improvement and permanent economy.

In concluding these very brief remarks on the mechanism of the steam-engine, it is not consistent with the design of these papers to enlarge on mechanical details, nor to refer to questions quite separate from the economy of steam power, our chief aim being to draw attention to prominent defects, and especially to those that increase, needlessly, the maintaining and working cost of steam power.

Who knows, with any certainty, the effective duty of different classes of steam-engines, as compared with their indicated or total power? the power absorbed in friction may amount to 30, 40, 50, or 60 per cent., according to the perfection of the workmanship and arrangement of the parts of a steam-engine, and yet how seldom is a dynamometer applied. Ou land, of late years, dynamometers have been much introduced, even for engines of only 10 to 20 horse power, but in marine-engines, of 100 to 500 horse power, it might be supposed frictional knowledge and experience is of little importance, whether 100 or 200 horse power is required to overcome friction, is not considered of sufficient importance to justify an outlay of £50 in a dynamometer.

In our next paper, we shall endeavour to give a resumé of all the chief points alluded to in this and the five preceding papers.

LINES OF THE PACIFIC STEAM NAVIGATION COMPANY'S STEAM SHIPS "LIMA" AND "BOGOTA."

(Illustrated by plate No. 151.)

We present with this number of the Artizan a folding copper-plate engraving of the lines of the *Lima* and *Bogota,* sister ships, originally built and engined by Messrs. Napier and Sons, of Glasgow, for the Pacific Steam Navigation Company.

These vessels were for some time worked upon their stations between Panama and Valparaiso, but in consequence of the great success attained by Messrs. Raudolph, Elder, and Co., in the alterations effected in the ships previously handed over to them for the purpose of fitting with their improved engines and boilers, they were sent home to be similarly treated.

The success which Messrs. Randolph, Elder and Co. obtained in connection with the alteration of the *Valparaiso*, the first of the ships altered by them, has been exceeded in the *Lima* and *Bogota*, and we cannot do better than refer our readers to a description of the engines, &c. of those vessels, which will be found in a paper, by Mr. J. Elder, read before section G, at the Aberdeen meeting of the British Association, and which will be found reported *in extenso* in the present number.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Aberdeen Meeting, Sept. 14th to 21st, 1859.

PAPERS READ IN SECTION G.

REPORT OF THE COMMITTEE ON STEAM SHIP PERFORMANCE.

At the last meeting of the British Association, held at Leeds, September, 1858, this Committee was appointed, on the recommendation of the Mechanical Section, and the following resolution was passed, defining the nature of the objects submitted to their investigation:—

"That the attention of proprietors of steam vessels be called to the great importance of adopting a general and uniform system of recording facts of performances of vessels at sea under all circumstances, and that the following noblemen and gentlemen be requested to act as a committee to carry this object into effect, with £15 at their disposal for the purpose, and to report to the Association at its next meeting":—

Vice-Admiral Moorsom	J. Kitson, C.E.
The Marquis of Stafford, M.P.	W. Smith, C.E.
The Earl of Caithness	J. E. M'Connell, C.E.
Lord Dufferin	Charles Atherton, C.E.
Sir James Graham, Bart., M.P.	Professor Rankine, L.L.D.
W. Fairbairn, F.R.S.	J. R. Napier, C.E.
J. S. Russell, F.R.S.	Henry Wright, *Secretary*

Your Committee, having elected Vice-Admiral Moorsom to be their Chairman, beg leave to present the following Report:—

They have held regular monthly meetings. Intermediate meetings of a sub-committee, presided over by the Chairman, for the purpose of carrying out matters of detail submitted to them by resolutions passed at the general meetings, have also been held.

Your Committee deemed it advisable, at an early stage of the enquiry, to call to their aid the following noblemen and gentlemen, Owners of Steam-yachts, and others, who have rendered valuable assistance:—

C. R. M. Talbot, Esq., M.P.	The Hon. A. Ellis, M.P.
G. Bentinck, Esq., M.P.	Lord John Hay, M.P.
Lord Hill.	The Hon. Captain Egerton, R.N.
Lord Clarence Paget, M.P.	Admiral Paris, of the Imperial Navy of France.

Not being Members of the British Association, however, they lent their assistance as corresponding members of the Committee.

The first object your Committee had in view was to obtain exact experimental data of such a nature as should appear likely to promote improvement in the construction and performances of steam-vessels.

With this view they furnished to members of Yacht Clubs, to Shipowners, to Shipbuilders, and Engineers, and to some of the large Steam-ship Companies, a Circular and Form of Return to be filled up with the particulars of the trial performances of their vessels.

The Return was intended to contain such particulars of the trials in smooth water at the measured mile, as it is usual to obtain for the satisfaction of the Designer of the vessel, and the Builder of the engines. The Committee believe that *authenticated facts* recorded in this form would materially aid the scientific Naval Architect and the practical Shipbuilder, together with the Engineer, in determining many elements which are at present held as opinions only, and about which considerable differences prevail. By obtaining the particulars of the sea performances of the same vessels, means would be thus afforded of making such comparisons with the smooth water performances as could not fail to throw light upon qualities of vessels which, as yet, are matter of speculation only.

Your Committee, conceiving it very desirable, if possible, to obtain the co-operation of the Admiralty, presented a memorial to the First Lord, setting forth that, in the opinion of the Committee, it would be conducive to the advancement of science, the improvement of both vessels and engines, and to the great advantage of Her Majesty's service, if the trials of the Queen's ships were conducted on a more comprehensive plan, directed to definite objects of practical utility, on a scientific basis, and recorded in a uniform manner, and that the Committee believe that exact experiments and scientific records of performances, such as they are now contemplating, would lay the foundation of improvements in Naval Architecture, so that for the future it would be practicable to build ships, whether for the Royal Navy, or for the Merchant Service, possessing high speed, great capacity, small draft of water, economy of power, and all the qualities which constitute a good sea-going ship, with much greater certainty than heretofore; and the Committee further stated that they were prepared, if desired, to conduct such experiments.

They also solicited an interview, in order that they might more fully explain their views.

A deputation consisting of

Admiral Moorsom	The Hon. Captain Egerton, R.N.
The Marquis of Stafford, M.P.	J. Scott Russell
The Earl of Caithness	J. E. M'Connell
Lord John Hay, M.P.	William Smith
Lord Clarence Paget, M.P.	Henry Wright
The Hon. A. Ellis, M.P.	

accordingly waited upon Sir J. S. Pakington, the late First Lord, and, in addition to the Memorial, they handed in a written statement, particularizing the nature of the experiments they considered desirable, together with the Circular and Form of Return for trial performances at the measured mile, which Form they suggested should be adopted by the Admiralty, instead of that already in use.

The Deputation was favoured with an interview of considerable length, and the subjects brought forward were fully discussed. The result was that the First Lord admitted the great importance of the subject, and promised that the statements of the Committee should receive every consideration.

Political changes, however, having intervened, no steps had been taken for practically carrying their suggestions into effect, but your Committee have been informed that the consideration of the subject has been taken up by the present Administration.

Your Committee waited by deputation also on the Board of the Royal Mail Company, and after explaining their objects, and laying before the Board copies of the same documents as had been presented to the Admiralty, received the assurance that the Directors were willing and desirous to render every assistance, by furnishing all the information they possessed, as to the performance of the steam-vessels under their direction; and they have since furnished the trial data of the vessels fitted for sea since that date, as will be seen by the subjoined list of particulars communicated to this Committee.

The period, however, which has elapsed since the issue of the Circular and Form of Return being comparatively short, and the subject of scientific enquiry to mercantile men somewhat novel, the Committee feel that time is required to develope the interest, both in a commercial and a scientific point of view, which it so justly demands.

Your Committee have also been in communication with the Peninsular and Oriental Steamship Company, the West India Mail Company, and some large Proprietors of Steam-vessels, into whose hands they have placed the Forms of Return, and have received the assurance that, as opportunity offers, they shall be filled up and returned, in compliance with the Committee's request.

A communication was made on the subject to the American Ambassador, and copies of the Circular and Form have been forwarded by him to his Government with a request for such information as to the trials of the United States Government vessels as can be furnished.

Your Committee have given their attention to the question of *recording facts at sea*. Upon examining the different Logs which have been laid before them, they found the particulars given so incomplete as to be unavailable for data upon which to base calculations for scientific improvement. To remedy this in future, they have, after careful examination and repeated discussion, agreed to a form of Log to be filled up on actual sea service.

In arranging the particulars for the Log, the Committee were materially assisted by very comprehensive Forms transmitted by Admiral Paris, of the Imperial French Navy, and also by a letter from him, giving very circumstantial information on all the points to which scientific inquiry might be directed.

The object of it is to supply an authentic record of actual performance at sea, in order to compare it with the performance at the measured mile. It forms, in fact, a sequel to the Returns proposed to be made on the test trials of vessels.

The Committee have had Log-books* prepared for the use of Steam-ship Companies; and as they include all the useful particulars at present recorded in the ordinary ship's log, the Committee anticipate concurrence in its general adoption.

Accompanying the Log-books are loose Return sheets, which the Commander and Engineer are invited to fill up from the Log, and to return for the use of the Committee.

Your Committee beg to lay before the Association a statement of the result of their endeavours to obtain a record of the performances of steam-vessels.

The first is a complete set of Returns of the performance of the Chester and Holyhead Company's steam-boats, plying between Holyhead and Kingstown, presented by Admiral Moorsom. They consist of:

I. 1. Return of the performances of the Chester and Holyhead Company's steam-vessels, under trial for a standard test.
2. Return of the speed and consumption of fuel of the steam-boats under regulated conditions of time, pressure, and expansion, for given periods (1848 to 1850.)
3. Return of the speed and consumption of coal of the express and cargo boats, under regulated conditions of time, pressure, and expansion, from January 31st, 1857, to 31st December, 1858.
4. Verification of consumption of coal, from January 1st, 1857, to December 31st, 1858.
5. Abstract of time of renewal of boilers, miles run, consumption of coals per mile, &c.
6. Return of shortest passages.
7. Return of mileage run, and expense per mile.

II. Return of particulars respecting the Chester and Holyhead Company's steam vessels *Anglia*, *Cambria*, *Scotia*, and *Telegraph*, on their trials, filled in to the Committee's form of return.

* The Log Book is arranged in precisely the same form as the return from Log. See Table to be given next month.

III. 1. Return showing the result of experiments with the steam-yacht *Undine* on the measured mile at Greenhithe, July 6th, 1858.
2. Do. do. on passage from Holyhead to the Mull of Cantyre, July 29th and 30th, 1858.
3. Do. do. in Loch Ness and Loch Lochy, October 26th and 27th, 1858.
IV. Return showing experiments with the steam yacht *Erminia*, in Stokes Bay, Oct 12, 1858.
V. Return of particulars respecting the steam-ship *Mersey* whilst under trial. Furnished by the Royal Mail Company.
VI. Return of particulars respecting the steam-ship *Paramatta*, whilst under trial. Furnished by the Royal Mail Company.
VII. Return of particulars respecting the steamship *Lima*, whilst on trial, between Liverpool and Dublin. Furnished by the Pacific Steam Navigation Company.
VIII. Return of particulars respecting the steamship *Admiral*, whilst under trial. Recorded and furnished by Dr. Rankine.
IX. Return of particulars respecting the steamship *Emerald*. Furnished by Mr. Thos. Steele, of Ayr.

Your Committee consider that it does not devolve upon them to institute any comparisons, or attempt to draw any conclusions, from the Returns of Performances laid before them.

Their duty is to collect information from authentic sources; but they do not hold themselves answerable for the facts with which they may be furnished.

The Returns now made public will doubtless receive the notice of scientific and practical men, and the Committee anticipate benefits to science not less than to the commercial interests of the country, by the scrutiny which the facts stated will doubtless undergo by individuals engaged in these pursuits.

It is by the investigations of such persons, that truth will be more satisfactorily brought out, and nature's laws vindicated, than by any attempt of the Committee in their collective capacity, but in which it is hoped individual Members will bear their part; and wheu the caution which now naturally keeps back many from contributing their quota of information shall be removed by experience of the practical use of the labours of the Committee, and of their singleuess of purpose, it may be expected that the materials of which the British Association will be the recipient, and which will be accessible to the world at large, will place what at present can only be called the Art of Ship-building, on the foundation of that pure science which acts in harmony with nature's laws.

The Records of Performance of H. M. Screw Vessels having been pnblished subsequently to the commencemeut of the sittings of your Committee, they beg to express their sense of the wisdom of such a course, which they trust will be persevered in.

These Records in the form of a blue book were well known to many, and Mr. W. Smith, C.E., a member of your Committee, had procured a copy for their use, which it was intended should be introduced into the Appendix of this Report, but which the publication renders now unnecessary.

These Records are, however, incomplete as scientific data, as will be seen on comparing them with the Form furnished to the Admiralty by your Committee.

In conclusion, the Committee recommend the reappointment of a Committee, enlarging their powers to embrace Returns relating to Sailing Ships, with a grant of money to enable them to collect information through their Secretary, and to defray the expenses of printing.

They cannot close this Report without expressing their best thanks to Mr. W. Smith, C.E., for the use of a room in his offices, and also for his kind liberality in printing and presenting to the Committee the Circulars, Forms, Logs, Returns, &c., here referred to.

They beg also thus to thank Mr. J. Yates for the kindness which enabled the Committee, at their early meeting to avail themselves of the use of his room in Buckingham Street.

On behalf of the Committee,
C. R. Moorsom, Vice-Admiral,
Chairman.

Office of the Committee,
19, Salisbury Street, Adelphi.

APPENDIX I.

Feb. 23rd, 1859.

Committee on Steamship Performance.

Sir,—I am requested by the Committee to submit for your consideration the circular on the other side, together with the enclosed form for return, any of the particulars of which, being authentic, the Committee will be glad to have.

Any further, or more circumstantial details which you may be pleased to give, the Committee will consider very valuable.

The object of the Committee being to lay the particulars thus obtained before the British Association at its next meeting, the Committee will esteem it a favour if you will give the matter your early attention.

I am, Sir, your very obedient servant,
Henry Wright, Secretary.

CIRCULAR.

(See page 58, Artizan for March, 1859.)

APPENDIX II.

Memorial presented to the First Lord of the Admiralty.

The Memorial of the Committee of the British Association for the Advancement of Science, called "The Committee on Steam Ship Performance." To the Right Honorable Sir John S. Pakington, Bart., First Lord of the Admiralty,

Sheweth—

That the Committee was appointed at the meeting of the British Association at Leeds in September last;

That their object is to obtain and make public through the Association authentic facts of the performance of steam vessels with the conditions and circumstances connected with such performances;

That they are aware that each steam vessel of the Royal Navy undergoes a certain trial previous to being put in commission for service;

That a series of such trials from the year 1842 to 1850 was printed and circulated, by which the cause of science was advanced, and the public service benefitted;

That the Committee have also before them a second series of such trials up to the year 1856, which, though printed, has not, as the Committee believe, been yet made public;

That similar trials of vessels of the Merchant Service have been made since the first introduction of steam power, and are continued to this day;

That such trials being made for the satisfaction of private persons, have not been made public in any authentic form, and are not available for the advancement of science, nor for the public benefit;

That the Committee have reason to believe that Steamship Companies, Ship builders, and Engineers will give publicity to the trials of their vessels, through the instrumentality of the Committee, reasonable satisfaction being given that such use shall be made of the information as may conduce to advance science, and to the public benefit;

That it would tend to the advancement of science, the improvement of both vessels and engines, and to the great advantage of Her Majesty's service, if the trials of the Queen's ships were conducted on a more comprehensive plan, directed to definite objects of practical utility on a scientific basis, recorded in a uniform manner;

That the Committee believe that exact experiments and scientific records of performance, such as they are now contemplating, would lay the foundation of improvements in Naval Architecture, so that for the futurc it would be practicable to bnild ships, whether for the Royal Navy or Merchant Service, possessing high speed, great capacity, small draft of water, economy of power, and all the qualities which constitute a good sea-going ship, with much greater certainty than heretofore, and the Committee are prepared to advise, and, if desired, to conduct such experiments;

That the Committee solicit an interview with the First Lord of the Admiralty, at as early a day as may be convenient, for the furtherance of the objects herein stated.

On behalf of the Committee,
(Signed) C. R. Moorsom, Vice Admiral,
Chairman.

February 17th, 1859.

APPENDIX III.

Statement handed in to the First Lord of the Admiralty by the Deputation, particularizing the nature of the experiments which the Committee considered desirable should be made:—

1. Experiments showing the resistance by dynamometer to being towed through the water under the three following conditions:
   - The hull when launched.
   - do. with machinery on board.
   - do. when ready for sea.
2. Experiments to determine the actual measure of stability under the above conditions.
3. Experiments shewing the resistance when propelled by steam under similar circumstances, both by indicator and dynamometer.

These experiments to be accompanied by the following particulars:

1. The lines, dimensions, and ordinary elements of construction of the ship, such as displacement, dimensions, and tonnage, area of midship section, area at load water line, area of wet surface, &c., &c., calculated measure of stability, and other elemeuts of form.
2. Dimensions and number of boilers, grate surface, fire surface, tube surface, number, length, and diameter of tubes, and how disposed, number and dimensions of furnaces, &c., other elements of construction, regulation pressure, working pressure, &c.
3. Plan of engines, dimensions of cylinders, condenser and air pumps, description of valves, indicator diagrams, speed of piston, &c.
4. Propeller—nature and dimensions, condition of draft and immersion when working, measure of slip, propelling force by dynamometer, propelling power by indicator, &c.

APPENDIX IV.

For Trial Form of Return, see pp. 58 and 59, Artizan for March, 1858.
The form of Returu from Engineer's Log will be given in the next Number of The Artizan.

APPENDIX V.

Explanatory statement to accompany the Returns relating to the Chester and Holyhead Company's steam vessels: (See Report, p. 3, and Tables 1 to 15, inclusive. Appendix V.)

For a full understanding of the Returns numbered 1 to 6, it is necessary to give such explauation as may enable any one to compare the purpose they were designed to serve with its fulfilment.

The heading under which each Return is noted in the schedule in some degree affords this explanation, but not altogether, and the followiug remarks will supply the deficiency.

When the four passenger vessels, *Anglia*, *Cambria*, *Hibernia*, and *Scotia* were first employed in August, 1848, the Commanders were authorized to drive them as hard as they could, subject only to the injunction not to incur danger.*

After some months' trial the qualities of each vessel and her engines were ascertained, and a system was brought into operation which continues to the present time. (Tables 3—15.)

The returns No. 2 and No. 6 shew the results of the *hard driving*, and of the commencement of *the system* periods. The column indicating "time," "pressure," and "expansion," is the key to the columns "average time of passage," "weight on safety valves," and "proportion of steam in cylinder," and as a sequence also to the consumption of coal.

"Time a minimum" shews the *hard driving*. "Time a constant" shews *the system*. The relations of "pressure" and "expansion" shew how, under *hard driving*, the highest pressure and the full cylinder produced the highest speed the wind and tide admitted, or how, the time being a constant, those two elements were varied at the discretion of the Commander, within prescribed limits, to meet the conditions of wind and tide.

The result of the *system* on the coal is a decreasing consumption.

The Return No. 1 shews the results of certain trials under favourable conditions, but in the performance of the daily passage, by four of the vessels, which results are used as the standard tests with which the results of each quarter's returns are compared.

For example, the *Scotia* at 15.9 stat. miles an hour, consumes 6,840 lbs. of coal as a standard. (See Table 4.)

In the Return No. 3 at the speed of 12.96 miles, she consumed 5,226 lbs., the first at the rate of 430 lbs. per mile (See Table 5.), and the second at about 403.

Again in the succeeding quarter the *Scotia* consumed 7,528 lbs. at 14.65 miles an hour, or more than 513 lbs. per mile.

Here was a case for inquiry and explanation. It will be observed that in Return No. 1 the consumption of the *Scotia* at ordinary work at sea is 5,820 lbs. per hour, and it is only when the consumption exceeds 6,840 lbs., that it becomes a subject of question; the difference between those figures being allowed for contingencies.

No. 4 (See Tables 12 & 13.) is a Return which shews the difference between the issues of coal each half year, and the aggregate of the returns of consumption, the object of which needs no elucidation.

No. 5 (See Table 14.)shews the duration of the boilers, with particulars of the work done. The saving in money under the return system as compared with hard driving, was of course very considerable, and the latter was only justifiable as a necessary means of learning the qualities of each vessel, to be afterwards redeemed by the economy of *the system*.

The *Hibernia*, it will be seen, was unequal to the service; and I may here observe, that experience has shewn me that in machinery, as in animal power, it is essential that it should be considerably above its ordinary work.

The want of this extra power was a defect of the early locomotive engines, whose cost of working per mile was very considerably higher than that of the engines now in use.

This defect, which is that of boiler power, prevails largely in steam vessels and especially in the Queen's ships.

It would be easy to show how system *must* tend to economy; and the saving of coal is apparent from the returns, and of course all the engine stores are commensurate.

But the repairs—the wear and tear—involve a much more important element of economy than even a reduced consumption of coal.

Now it must be obvious that neither this nor any other attempt to bring an establishment like that at Holyhead under the supervision of a central authority at a distance, could be effectual without a perfect confidence and understanding between the parties.

This has happily subsisted for some years, and the superintendent, Captain Hirste, must have the credit of having cordially entered into and faithfully carried out his instructions, for many of which he has furnished suggestions.

March 8, 1859. C. R. MOORSOM.

* See Evidence before Select Committee of House of Commons, 1850 aud 1853.

APPENDIX V. Continued.—Table 3.

CHESTER AND HOLYHEAD RAILWAY—STEAMBOAT DEPARTMENT 1857.

A Return of the Speed and Consumption of Coal, under regulated conditions of Time, Pressure and Expansion, for the undermentioned period.

VESSEL.	Date.	No of Trips run.	Time of Passage.			Average rate sf Speed. Miles.	Actual Weight on Valves.	Average pressure Worked at.	Proportion of Steam in Cylinder.	Coals Consumed.		
			Longest.	Shortest.	Average.					Per Trip, including getting up steam & while lying at Holyhead	Per Hour, inclusive of raising steam, banking fires, &c.	Per Hour exclusive of raising steam, banking fires, &c.
										Ton cwt lbs	Ton cwt lbs	Ton cwt lbs
Anglia	1 Jan. to 31 March, 1857	72	6.43	4.0	4.30	14.00	16lbs	$11\frac{1}{3}$	$\frac{20}{36}$	13 3 77	2 18 66	2 5 106
Cambria	Ditto	75	8.26	4.9	4.35	13.75	15lbs	$14\frac{1}{2}$	$\frac{26}{36}$	13 0 12	2 16 84	2 3 9
Scotia	Ditto	7	5.23	4.32	4.52	12.96	14lbs	$8\frac{1}{2}$	$\frac{15}{36}$	15 14 0	3 4 58	2 12 88
Telegraph	Ditto	Nil.										
Hibernia	Ditto	23	9.0	6.30	7.14	9.26	8lbs	6	$\frac{13}{36}\frac{15}{36}$ & $\frac{17}{36}$	13 7 0	1 16 102	1 8 69
Sea Nymph	Ditto	54	8.26	5.0	5.58	11.24	14 & 12	11	1&2 Gra.	12 1 41	2 0 50	1 10 81
Ocean	Ditto	71	16.25	6.20	7.36	8.81	10lbs	$7\frac{4}{7}$	Nil.	11 3 42	1 9 43	1 4 43
Hercules	Ditto	28	9.30	6.0	7.12	9.30	8lbs	$7\frac{5}{12}$	Nil.	9 9 56	1 6 35	1 2 17

Steam Packet Office, Holyhead, 9th April, 1857. (Signed) William Storey.

APPENDIX V. Continued.—Table 4.

CHESTER AND HOLYHEAD RAILWAY.—STEAMBOAT DEPARTMENT.

A Return of the speed and consumption of coal of the steamboats, under regulated conditions of time, pressure, and expansion, for the undermentioned period.

VESSEL.	Date.	No. of Trips run.	Passages.			Average rate of Speed—Miles.	Actual Weight on Valves.	Average pressure worked at.	Proportion of Steam in Cylinder.	Coals consumed.			Remarks
			Longest.	Shortest.	Average.					Per trip, including getting up steam & while lying at Holyhead	Pr hour including raising steam, banking fires, &c.	Per hour, exclusive of raising steam, banking fires, &c.	
			h. m.	h. m.	h. m.		lbs.	lbs.		Tons cwt lbs	Tons cwt lbs	Tons cwt lbs	
Anglia	1 April to 30 June, 1857	61	5 5	4 0	4 20	14·52	16	12	$\frac{20}{6}$, none	13 6 70	3 1 59	2 8 44	
Cambria	Ditto.	76	4 57	4 8	4 28	14·13	15	15	$\frac{26}{36}$	12 15 24	2 17 15	2 3 96	
Scotia	Ditto.	17	4 33	4 3	4 18	14·65	15	12		14 9 6	3 7 24	2 13 106	
	Special Service.												
Telegraph	1 June to 30 June, 1857.	40 }	4 48	4 0	4 13	14·94	14	13	$\frac{21}{36}$, none	13 13 70	3 4 99	2 11 15	
Cambria	On the 30th June, 1857.	2 }											
Hibernia	Nil.												
Sea Nymph	1 April to 30 June, 1857.	83	7 22	5 5	6 0	11·06	12	$11\frac{1}{4}$	2d grade	10 14 6	1 15 75	1 6 1	
Ocean	Ditto.	61	10 40	5 55	7 12	9·53	10	$7\frac{1}{4}$	Nil.	10 5 30	1 8 57	1 3 25	
Hercules	Ditto.	44	8 0	5 50	6 42	10·14	8	7	Nil.	8 8 52	1 5 16	1 0 74	

Steam Packet Office, Holyhead, 24th July, 1857.

APPENDIX V. Continued—Table 1.

Return of the performance of the Chester and Holyhead Company's steam-vessels, under trial for a standard test.

NAME OF VESSEL.	Cylinders.				Steam Pressure.		Weight per square inch on Safety Valve.	Barometer Index.	Hydrometer Index.	Nominal Horse Power.	Area of Heating Surface		Number of Boilers.	Paddles.		Floats.			Revolutions per Minute.	Load Water Line.			Mid-Section Area, in square feet.	Displacement, in tons.	Under Steam.				
	Diameter.	Length of Stroke.	Number.	Strokes per Minute.	On Piston, in lbs per square inch.	In Boilers, in lbs per square inch.					Tubes.	Furnaces.		Diameter.	Effective Diameter.	Breadth.	Depth.	Dip.		Length.	Breadth.	Mean Draught ex Keel.			Speed in Statute Miles per Hour. Trial in Smooth Water. Vessel.	Travel of Wheel between Holyhead & Kingstown (trial trip), in Statute Miles.	Slip of Wheel (trial trip), in Statute Miles.	Consumption of Coal in lbs. per hour. Trial in Smooth Water	Indicator HP giving the speed as before when on Trial in Smooth Water
	In.	Ft. In.												Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.		Ft. In.	Ft. In.	Ft. In.							
Anglia	$48\frac{1}{2}$	4 6	4	50	7.28	15	15	$25\frac{1}{2}$	1.6	330.52	3892.44	456	2	24 6	23 4	9 6	3 8	5 2	25	187 10	26 2	9 0	186.25	620	15.40	$84\frac{3}{4}$	$19\frac{3}{4}$	7630	891.76
Cambria	$73\frac{1}{2}$	5 0	2	46	8.20	15	15	$26\frac{1}{2}$	$1\frac{1}{4}$	392.10	5519.	450	4	28 0	27 0	7 0	4 0	5 10	23	197 9	26 2	8 $10\frac{1}{2}$	201.10	840	14.78	$89\frac{1}{5}$	$24\frac{1}{5}$	7341	1005.22
Scotia	52	4 6	4	48	7.58	15	15	27	1.7	319.92	4618.41	586.5	2	24 6	23 4	10 0	3 8	6 0	24	192 7	27 0	8 10	188.78	680	15.90	$84\frac{1}{4}$	$19\frac{1}{4}$	6840	1006.68
Telegraph	$77\frac{1}{4}$	5 6	2	50	7.60	14	14	26	$1\frac{3}{4}$	448.0	7382.76	462	2	26 6	25 6	10 0	4 0	4 5	25	243 8	28 2	9 8	224.70	1173	15.32	$84\frac{9}{10}$	$19\frac{9}{10}$	8235	1165.98

Deduct about 13cwt. as the proportion per hour of consumption of coal for getting up steam, banking fires, etc.

APPENDIX V. Continued.—Table 2.

Copy of a Return laid before a select Committee of the House of Commons. See Blue Book on Dublin and Holyhead Mail Service, 1853. Appendix, p. 176. A Return of the Speed and Consumption of Fuel of the Steamboats under regulated conditions of time, pressure, and expansion, for the undermentioned periods.

NAME OF BOAT.	Date.	Number of Trips of 63 statute Miles or 54.6 Nautical.	Time of Passage. Longest.	Shortest.	Average.	Average rate of Speed in Stat. Miles.	Weight on Safety Valves. Greatest.	Least.	Proportion of Steam in Cylinders.	Coal. Supplied.	Consumption.	Orders under which each Vessel was directed to use the Elements of Time, Pressure, and Expansion.
				* *						Tons.	Ton cwt lb	
Auglia.	1 Aug. to 31 Dec. 1848.	76	5.20	3.25	2.50	15.8	19	11	$\frac{29}{54}$ to $\frac{3}{5}$	$1161\frac{1}{4}$	15 5 $2\frac{7}{9}$	Time a minimum, pressure maximum, expansion a minimum.
	1 Jan. to 30 June, 1849.	68	6.58	3.23	4.14	14.8	13	13	$\frac{4}{9}$ to $\frac{3}{5}$	963	14 $3\frac{4}{17}$	Time a constant, pressure a constant, expansion according to tide, wind and weather
	1 July to 31 Dec., 1849.											
	1 Jan. to 31 March, 1850.	31	5.29	4.6	4.31	13.9	17.4	13.2	$\frac{1}{2}$ to $\frac{3}{5}$	337	10 10 $3\frac{3}{4}$	Time a constant, pressure expansion according to tide, wind, and weather.
Cambria	1 Aug. to 31 Dec., 1848.	96	7.0	4.5	4.28	14.1	14	12	$\frac{1}{2}$ to $\frac{3}{4}$	1457	15 3 $2\frac{1}{3}$	Time a minimum, pressure a constant, expansion a constant.
	1 Jan. to 30 June, 1849.	149	6.10	4.5	4.30	14	12	12	$\frac{1}{3}$ to $\frac{3}{4}$	$2203\frac{1}{2}$	14 $16\frac{1}{2}$	Time a constant.
	1 July to 31 Dec., 1849.	89	6.41	3.57	4.25	14.2	14	12	$\frac{1}{3}$ to $\frac{3}{4}$	1044	13 1 0	Pressure expansion according to wind, tide, and weather.
	1 Jan. to 31 March, 1850.	61	5.58	4.0	4.34	12.5	14	12	$\frac{1}{3}$	752	12 6 $2\frac{1}{2}$	Time a constant, pressure a constant, expansion a constant.
Hibernia	1 Aug. to 31 Dec,. 1848.	27	6.40	4.18	5.16	11.5	15	11	$\frac{1}{2}$ to $\frac{3}{5}$	$624\frac{1}{2}$	23 $2\frac{24}{27}$	Unable to accomplish the conditions imposed as to time except under very favourable circumstances.
	1 Jan. to 30 June, 1849.	25	6.38	4.13	5.0	12.2	14	14	$\frac{1}{2}$ to $\frac{3}{5}$	571	16 $16\frac{2}{5}$	
	1 July to 31 Dec. 1859.	123	7.10	4.12	4.55	12.4	15	12	$\frac{1}{2}$ to $\frac{7}{10}$	$1907\frac{1}{2}$	15 $5\frac{1}{15}$	
	1 Jan. to 31 March, 1850.	29	6.22	4.30	5.10	12.1	15	15	$\frac{5}{8}$ to $\frac{3}{4}$	530	18 $5\frac{6}{29}$	
Scotia	1 Aug. to 31 Dec., 1848.	60	6.45	3.28	3.59	15.5	19	$10\frac{3}{4}$	$\frac{1}{2}$ to $\frac{11}{18}$	1030	17 $3.1\frac{1}{3}$	Time a minimum, pressure expansion according to tide, wind, and weather.
	1 Jan. to 30 June, 1849.	59	7.38	3.24	4.9	15.1	19	$10\frac{3}{4}$	$\frac{4}{9}$ to $\frac{11}{18}$	932	15 $15\frac{55}{59}$	Time a constant, pressure expansion according to tide, wind, and weather.
	1 July to 31 Dec., 1849.	106	6.19	3.56	4.38	13.3	$15\frac{1}{2}$	$5\frac{1}{2}$	$\frac{4}{9}$ to $\frac{11}{18}$	1413	13 $4\frac{20}{106}$	
	1 Jan. to 31 March, 1850.	35	6.42	4.0	4.29	14.06	$10\frac{3}{4}$	$10\frac{3}{4}$	$\frac{4}{9}$ to $\frac{11}{18}$	472	13 9 $2\frac{6}{7}$	Time, a constant, pressure expansion according to tide, wind, and weather.

Note.—The above vessels, during the period named, were worked at steam pressure as follows, viz:—Anglia, ranging between 19 and 10.2lbs.; Cambria, 14 and 12 lbs.; Hibernia, 15 and 11; Scotia, 19 and $10\frac{3}{4}$

* * Length of passages not limited up to 1850. From that period passages were not to be made in less time than four hours. Draught of water at the time corresponding with passages shewn was:—Anglia, 8ft. $6\frac{1}{2}$in. Scotia, 8ft. $5\frac{1}{4}$in.; Cambria, 9ft. $3\frac{1}{2}$in.; Hibernia, 8ft. 8in.

APPENDIX V. Continued.—Table 5.

CHESTER AND HOLYHEAD RAILWAY.—STEAMBOAT DEPARTMENT.

A Return of the speed and consumption of coal of the steam boats under regulated conditions of time, pressure, and expansion for the undermentioned period.

VESSEL.	Date.	No. of trips run.	Passages.			Average rate of Speed. Miles.	Actual Weight on Valves.	Average pressure Worked at	Proportion of Steam in Cylinder.	Coals consumed.			Remarks
			Longest.	Shortest.	Average.					Per trip, including getting up steam & while lying at Holyhead.	Per hour, including raising steam, banking, firing, &c.	Per hour, exclusive of raising steam, banking, fires, &c.	
			h. m.	h. m.	h. m.		lbs.	lbs.		Ton cwt lbs	Ton cw tlbs	Ton cwt lbs	
Anglia	1 July to 30 Sept., 1857	98	4 52	4 5	4 25	14·22	16	$12\frac{3}{4}$	$\frac{20}{36}$, $\frac{23}{36}$, none	12 0 0	2 14 38	2 1 48	
Cambria	Ditto	58	5 20	4 9	4 29	14·19	15	15	$\frac{26}{36}$	12 8 46	2 15 0	2 2 0	
Scotia	Ditto	56	5 28	4 1	4 20	14·53	15	$12\frac{3}{4}$	$\frac{18}{36}$, $\frac{21}{36}$, none	13 14 76	3 3 43	2 10 24	
Telegraph	Ditto	78	6 15	4 5	4 24	14·31	14	$12\frac{1}{2}$	nil.	16 7 7	3 14 27	3 1 15	
Hibernia	Ditto	76	7 30	5 19	6 14	11·22	15	$8\frac{1}{2}$	nil.	13 1 16	2 2 0	1 12 30	
Hercules	Ditto	19	8 10	6 15	6 53	10·17	8	$7\frac{1}{2}$	nil.	8 12 41	1 5 0	1 10 16	
Ocean	Ditto	12	7 45	6 0	6 54	10·14	10	9	2 grade	9 15 0	1 8 29	1 4 21	
Sea Nymph	Ditto	83	9 20	5 15	6 6	11·48	12	$11\frac{1}{2}$	full cylinder.	9 13 0	1 11 71	1 2 14	

APPENDIX V. Continued.—Table 6.

CHESTER AND HOLYHEAD RAILWAY.—STEAMBOAT DEPARTMENT.

A RETURN of the Speed and Consumption of Coal of the Steam Boats nnder regulated conditions of Time, Pressure, and Expansion for the undermentioned period.

Vessel.	Date.	No. of Trips run.	Passages.			Average rate of Speed. Miles.	Actual Weight on Valves.	Average Pressure Worked at	Proportion of Steam in Cylinder.	Coals Consumed.			Remarks.
			Longest.	Shortest.	Average.					Per Trip, including getting up Steam & while lying at Holyhead.	Per Hour, including raising Steam, Banking, Fires, &c.	Per Hour, exclusive of raising Steam, Banking, Fires, &c.	
			h. m.	h. m.	h. m.		lbs.	lbs.		Ton cwt lbs	Ton cwt lbs	Ton cwt lbs	
Anglia	1 Octr. to 31 Decr., 1857,	25	5 12	4 3	4 22	14·22	16	$13\frac{1}{4}$	$\frac{23}{36}$	12 5 0	2 16 11	2 3 6	
Cambria	Ditto	74	6 10	4 11	4 50	13.02	15	12	$\frac{26}{36}$	12 19 39	2 13 69	2 1 42	
Scotia	Ditto	59	6 0	4 11	4 36	13·69	15	$11\frac{1}{2}$	$\frac{15}{36}$	12 15 81	2 15 48	2 3 4	
Telegraph	Ditto	16	*6 55	*4 11	4 26 } 4 50 }	14·21	15	$11\frac{1}{2}$	$\frac{15}{36}$ $\frac{18}{36}$	13 12 0	2 06 30	2 4 10	
Hibernia	Ditto	78	9 10	5 40	6 37	10·57	15	$7\frac{3}{4}$	$\frac{15}{36}$	14 6 56	2 3 25	1 14 102	
Sea Nymph	Ditto	74	11 30	5 15	6 48	10·26	12	11	2 grade	10 11 15	1 11 3	1 2 56	
Ocean	Ditto	40	11 45	6 0	7 50	8·93	10	$8\frac{3}{4}$	full	10 11 55	1 6 104	1 2 38	
Hercules	Ditto	Nil											

* Slow speed accident

Correct from Returns in Office. (Signed) THOS. HIRSTE.

APPENDIX V. Continued.—Table 7.

CHESTER AND HOLYHEAD RAILWAY—STEAMBOAT DEPARTMENT.—A Retnrn of the Speed and Consumption of Coal of the Steamboats, under regulated conditions of Time, Pressure, and Expansion, for the undermentioned periods

VESSELS	Date.	No. of Trips run.	Passages.			Average rate of Speed—Miles.	Actual Weight on Valves.	Average Pressure worked at.	Proportion of Steam in Cylinders.	Coals consumed.			Remarks.
			Longest.	Shortest.	Average.					Per Trip, including getting up Steam while lying at Holybead.	Per Hour, inclnding raising Steam, banking Fires, &c.	Per Hour, exclusive of raising Steam, banking fires, &c.	
			h. m.	h. m.	h. m.		lbs.	lbs.		Tons cwt. lbs.	Tons cwt lbs	Tons cwt. lbs.	
Anglia	1 Jan to 31 March, 1858	72	7 0	4 0	4 36	13·69	16	13	$\frac{20}{36}$	12 10 14	2 14 27	2 1 101	
Cambria	Ditto	Nil.											
Scotia	Ditto	78	7 2	4 13	4 43	13·35	15	$12\frac{1}{2}$	$\frac{15}{36}$	13 3 81	2 15 92	2 3 83	
Telegraph	Ditto	Nil.											
Hibernia	Ditto	76	9 0	5 47	6 40	10·50	15	7	$\frac{11}{36}$ $\frac{13}{36}$	13 15 100	2 1 41	1 13 14	
Hercules	Ditto	28	12 0	6 5	7 35	9·23	12	11	Nil.	9 8 100	1 4 102	1 0 106	
Ocean	Ditto	36	14 21	7 18	7 38	9·17	10	$8\frac{1}{2}$	Nil.	10 3 0	1 6 61	1 1 94	
Sea Nymph	Ditto	44	9 20	5 20	6 50	10·24	12	$10\frac{3}{4}$	2d grade	10 12 71	1 11 7	1 2 66	

APPENDIX V. Continued.—Table 8.

CHESTER AND HOLYHEAD RAILWAY—STEAMBOAT DEPARTMENT.—A Return of the speed and consumption of Coal of the express and cargo boats, under regulated conditions of Time, Pressure, and Expansion, for the undermentioned period.

VESSELS.	Date.	No. of Trips run.	Passages. Longest.	Passages. Shortest.	Passages. Average.	Average rate of Speed—Miles.	Actual Weight on Valves.	Average Pressure Worked at.	Proportion of Steam in Cylinder.	Coals consumed. Per Trip, including getting up steam while lying at Holyhead	Coals consumed. Per Hour, including raising Steam, banking Fires, &c.	Coals consumed. Per Hour, exclusive of raising Steam, banking Fires, &c.	Remarks.
			h. m.	h. m.	h. m.		lbs.	lbs.		Tons cwt. lbs.	Tons cwt. lbs.	Tons cwt. lbs.	
EXPRESS VESSELS.													
Anglia	1 April to 30 June, 1858	59	8 1	4 5	4 34	13·79	16	$13\frac{1}{2}$	$\frac{20}{36}$	11 17 75	2 12 4	1 19 65	
Cambria	Ditto	40	4 42	4 12	4 24	14·31	15	15	$\frac{26}{36}$	12 1 23	2 14 91	2 1 38	
Scotia	Ditto	55	5 37	4 12	4 34	13·79	15	$11\frac{1}{2}$	$\frac{15}{36}$, $\frac{18}{36}$	13 1 44	2 17 26	2 4 83	
Telegraph	Ditto												
CARGO VESSELS.													
Hibernia	Ditto	75	8 45	5 45	6 19	11·08	15	$7\frac{3}{4}$	$\frac{13}{36}$	13 0 79	2 1 30	1 12 63	
Hercules	Ditto	19	9 30	6 0	6 38	10·55	12	$10\frac{1}{4}$	Nil.	7 17 17	1 3 75	19 18	
Ocean	Ditto	4	11 25	7 5	8 29	8·25	10	$8\frac{1}{2}$	Nil.	9 2 0	1 1 50	17 38	
Sea Nymph.	Ditto	77	9 35	5 25	6 23	10·96	12	10	2d Grade.	10 9 13	1 11 85	1 3 75	

APPENDIX V. Continued.—Table 9.

CHESTER AND HOLYHEAD RAILWAY—STEAM BOAT DEPARTMENT.—A Return of the Speed and Consumption of Coal of the Express and Cargo Boats, under regulated conditions of Time, Pressure, and Expansion for the undermentioned period.

VESSEL.	Date.	No. of Trips run.	Passages. Longest.	Passages. Shortest.	Passages. Average.	Average Rate of Speed. Mile.	Actual Weight on Valves.	Average Pressure worked at.	Proportion of Steam in Cylinder.	Coals consumed. Per Trip, including getting up Steam & while lying at Holyhead.	Coals consumed. Per Hour, including raising Steam, banking Fires, &c.	Coals consumed. Per Hour, exclusive of raising Steam, banking Fires, &c.	Remarks.
EXPRESS.			h. m.	h. m.	h. m.		lbs.	lbs.		Tons cwt lbs	Tons cwt lbs	Tons cwt lbs	
Anglia	1 July to 30 Septr., 1858	13	5 25	4 24	4 36	13·69	16	14		12 12 94	2 14 108	2 2 66	
Cambria	Ditto	17	5 21	4 12	4 30	14·00	15	$13\frac{3}{4}$	$\frac{26}{36}$	12 6 27	2 14 80	2 1 60	
Scotia	Ditto	Nil											* Longest passage, detained by dense fog.
Telegraph	Ditto	68	5 15	4 13	4 25	14·26	10	$8\frac{3}{4}$		13 11 82	3 1 58	2 8 43	
CARGO.													
Hibernia	Ditto	67	8 15	5 55	6 28	10·82	15	$7\frac{1}{2}$	$\frac{13}{26}$	13 14 40	2 2 43	1 13 103	
Hercules	Ditto	25	13 24*	6 10	7 4*	9·90	12	$10\frac{3}{4}$		8 2 22	1 2 106	0 18 79	
Ocean	Ditto	20	9 50	6 25	7 16	9·63	10	$7\frac{3}{4}$		10 1 16	1 7 76	1 2 81	
Sea Nymph	Ditto	71	13 53*	5 35	6 31	10·74	12	$10\frac{1}{2}$	2 grade	10 9 37	1 12 13	1 3 24	

APPENDIX V. Continued.—Table 10.

CHESTER AND HOLYHEAD RAILWAY—STEAM BOAT DEPARTMENT.—A Return of the Speed and Consumption of Coal of the Express and Cargo Boats, under regulated conditions of Time, Pressure, and Expansion for the undermentioned period:—

VESSELS	Date.	No. of Trips run.	Passages. Longest.	Passages. Shortest	Passages. Average	Average Rate of Speed. Miles.	Actual Weight on Valves.	Average Pressure Worked at	Proportion of Steam in Cylinder.	Coals consumed. Per Trip, including getting up Steam & while lying at Holyhead.	Coals consumed. Per Hour, including raising Steam, banking Fires, &c.	Coals consumed. Per Hour, exclusive of raising Steam, banking Fires, &c.	Remarks.
EXPRESS.			h. m.	h. m.	h. m.		lbs.	lbs.		Tons cwt lbs	Tons cwt lbs	Tons cwt lbs	* Cambria's longest passage, occasioned by a heavy easterly gale.
Anglia	1 Oct. to 31 Dec. 1858,	22	6 16	4 4	4 40	13·50	15	13	$\frac{15}{36}$ $\frac{16}{36}$	13 0 76	2 15 96	2 3 74	† Longest passage, occasioned by a heavy easterly gale.
Cambria	Ditto	57	7 38*	4 11	4 37	13·64	15	$13\frac{1}{2}$	$\frac{26}{36}$	12 15 72	2 15 42	2 2 59	
Scotia	Ditto	51	6 15	4 15	4 41	13·45	15	$11\frac{1}{2}$	$\frac{18}{36}$	13 14 19	2 18 60	2 6 41	
Telegraph	Ditto	24	5 10	4 18	4 32	13·87	10	9		13 11 102	2 19 109	2 7 21	‡ Ditto.
CARGO.													
Hibernia	Ditto	77	10 5†	5 30	6 42	10·44	15	$7\frac{1}{2}$	$\frac{13}{36}$ $\frac{15}{36}$ $\frac{17}{36}$	14 9 32	2 3 19	1 14 108	§ Longest passage, occasioned by dense fog.
Hercules	Ditto	75	14 40‡	6 0	7 29	9·35	12	$10\frac{3}{4}$		8 12 26	1 3 1	0 19 0	
Ocean	Ditto	14	9 32	6 25	7 52	8·90	10	$8\frac{1}{2}$	2 grade	11 1 8	1 8 11	1 3 58	
Sea Nymph	Ditto	77	13 5§	5 30	6 53	10·16	12	10		10 13 68	1 11 3	1 2 67	

APPENDIX V. Continued.—Table 11.

CHESTER AND HOLYHEAD RAILWAY.—STEAMBOAT DEPARTMENT.

Consumption of Coal for the Six Months ending 30th June, 1858.

Name of Vessel.	Period.	No. of Trips.	Average number of tons each trip.			Total for the six months.			Total as shown by General Account, including Coal on board.			Remarks.
			Tons	cwt.	lbs.	Tons	cwt.	lbs.	Tons	cwt.	lbs.	
Anglia	3 Months to 31 March	72	12	10	14	1601	11	57	1613	9	0	
	„ 30 June	59	11	17	75							
Cambria	„ 31 March					482	8	24	505	18	0	
	„ 30 June	40	12	1	23							
Scotia	„ 31 March	78	13	3	81	1747	7	2	1770	6	0	
	„ 30 June	55	13	1	44							
Telegraph	„ 31 March											
	„ 30 June											
Hibernia	„ 31 March	76	13	15	100	2021	19	77	2058	12	0	
	„ 30 June	75	13	0	79							
Hercules	„ 31 March	28	9	8	100	413	14	99	441	11	0	
	„ 30 June	19	7	17	17							
Ocean	„ 31 March	36	10	3	0	401	16	0	399	7	0	
	„ 30 June	4	9	2	0							
Sea Nymph	„ 31 March	44	10	12	71	1272	17	93	1273	18	0	
	„ 30 June	77	10	9	13							
						7941	15	16	8063	1	0	

APPENDIX V. Continued.—Table 12.

CHESTER & HOLYHEAD RAILWAY.—STEAMBOAT DEPARTMENT.—Consumption of Coal for the Six Months ending 30th June, 1858.

Name of Vessel.	Period.	No. of Trips.	Average number of tons each trip.			Total for the six months.			Total as shown by General Account, including Coal on board.			Remarks.
			Tons	cwt.	lbs.	Tons	cwt.	lbs.	Tons	cwt.	lbs.	
Anglia	3 Months to 30 Sept.	13	12	12	94	451	1	94	564	0	0	
	„ 31 Dec.	22	13	0	76							
Cambria	„ 30 Sept.	77	12	6	27	1676	12	23	1667	6	0	
	„ 31 Dec.	57	12	15	72							
Scotia	„ 30 Sept.					699	2	73	687	15	0	
	„ 31 Dec.	51	13	14	19							
Telegraph	„ 30 Sept.	68	13	11	82	1250	3	62	1229	4	0	
	„ 31 Dec.	24	13	11	102							
Hibernia	„ 30 Sept.	67	13	14	40	2032	16	104	2006	17	0	
	„ 31 Dec.	77	14	9	22							
Hercules	„ 30 Sept.	25	8	2	32	848	12	36	851	7	0	
	„ 31 Dec.	75	8	12	26							
Ocean	„ 30 Sept.	20	10	1	16	355	17	96	358	8	0	
	„ 31 Dec.	14	11	1	8							
Sea Nymph	„ 30 Sept.	71	10	9	37	1565	10	23	1568	11	0	
	„ 31 Dec.	77	10	13	68							
						8879	17	63	8933	8	0	

APPENDIX V. Continued.—Table 13.

A RETURN showing the number of years run before the Anglia, Cambria, Scotia, and Hibernia, had new Boilers, number of miles run, and consumption of Coal per mile, with and without raising Steam, banking Fires, lying at Kingstown and Holyhead, Steam Pressure in Boilers.

Name of Vessel.	Weight of Boilers.			Number of years run before receiving new Boilers.	Number of Statute Miles run.	Rate of speed per hour, Statute Miles.	Coals consumed per mile, including getting up steam, &c.			Coals consumed per mile in running only.			Mean pressure per square inch in Boilers.
	T.	cwt.	lbs.				T.	cwt.	lbs.	T.	cwt.	lbs.	lbs.
Anglia	47	10	3	8½	113,166	14.61	0	3	82	0	2	97	12
Cambria	75	4	1	8	103,944	14.51	0	3	95	0	2	110	11
Scotia	51	6	1	8½	107,592	14.75	0	4	10	0	3	26	11¾
Hibernia, Express	45	5	0	8½	20,800	12.62	0	4	54	0	3	68	12
Do. Cargo					78,225	10.31	0	3	37	0	2	66	8

The goods trade, time of passage limited to 6½ hours.

APPENDIX V. Continued.—Table 14.

CHESTER AND HOLYHEAD RAILWAY.—STEAM BOAT DEPARTMENT.—A RETURN of PASSAGES made by the STEAMBOATS in $3\frac{1}{2}$ hours, &c.

Name of Boat.	Date.	Time of		Length of Passages.	Valves, maximum at which set, or grades at which worked.	Steam Gnage or Indicator.		Expansion proportion in Cylinder.	Remarks.
		Departure from	Arrival at			Highest.	Lowest.		
				h. m.					
Anglia	1848 25 Aug.	Kingstown 9.11 A.M.	Holyhead 0.44 P.M.	3 33					The forms of Engineer's logs in office are from Nov. 1848 only. The quantity of coals consumed per trip was not furnished at the period of these returns; but taking one years' average from 1st August, 1848, to 31st July, 1849, and after deducting for raising steam and banking fires, it would stand as follows, viz: Anglia . . 12 tons Scotia . . 14 ,, or as near as can be ascertained.
,,	1 Sept.	9.9 ,,	0.41 ,,	3 32					
,,	2 ,,	9.9 ,,	0.42 ,,	3 33					
,,	16 ,,	Holyhead 6.35 P.M.	Kingstown 10.0 P.M.	3 25	15	16	14	$\frac{3}{5}$	
Scotia	4 ,,	Kingstown 9.7 A.M.	Holyhead 0.41 P.M.	3 34					
,,	12 ,,	Holyhead 6.33 P.M.	Kingstown 10.6 P.M.	3 33					
,,	18 ,,	Kingstown 9.10 A.M.	Holyhead 0.38 P.M.	3 28					
,,	1849 29 March	Holyhead 9.16 P.M.	Kingstown 9.40 P.M.	3 24	17	19	15	$\frac{4}{9}$	

APPENDIX V. Continued.—Table 15.

CHESTER AND HOLYHEAD RAILWAY.—STEAMBOAT DEPARTMENT.

Mileage run, and expenses per mile, of the Passenger Boats in the years 1849, and 1856, 1857, 1858.

	1849		1856		1857		1858	
Miles run	39,910		40,885		52,910		40,040	
Expenses.	Total.	Per mile.	Total.	Per mile,	Total.	Per mile.	Total.	Per mile.
	£	s. d.	£	s. d.	£	s. d.	£	s. d.
Wages	8,294	4 2	5,461	2 8	5,736	2 2	5,160	2 $6\frac{3}{4}$
Coal	5,420	2 $8\frac{1}{2}$	5,554	2 $8\frac{1}{2}$	6,387	2 5	4,354	2 2
Engiue Stores, Ship Sto res, and Repairs	4,890	2 $5\frac{1}{2}$	3,517	1 $8\frac{3}{4}$	3,592	1 $4\frac{1}{4}$	2,540	1 $3\frac{1}{4}$
Harbour Light Dues	1,609	0 $9\frac{1}{2}$	321	0 2	431	0 2	318	0 2
General Charges . .	425	0 $2\frac{1}{2}$	595	0 $3\frac{1}{2}$	1,316	0 6	1,172	0 7
Total . . . £	20,638	10 4	15,448	7 $6\frac{3}{4}$	17,462	6 $7\frac{1}{4}$	13,544	6 9

APPENDIX VI.

*** The Numbers in the Returns given below, correspond with the Numbers of the Columus in the TRIAL FORM of RETURN.—*See* Table, page 88, ARTIZAN, March 1, 1859.

RETURN OF PARTICULARS RESPECTING THE STEAM-SHIP "ANGLIA," WHILST UNDER TRIAL.

1. Between Holyhead and Kingstown, six trips, 29th September to 3rd October, 1854. 2. W.S.W. to N.N.W.; fine, moderate; tides favourable. 3. 2 tons, 16 cwt., 102 lbs. 4. 12 tons, 13 cwt., 3 lbs. per trip. 5. Not ascertained. 6. 729·70 to 891·76. 7. Paddle. 8. *See* column 1. 9. *See* columu 1. 10. 14.94 statute miles. 11. 187 ft. 10 in. 12. 186·25 square feet midsection. 13. 9ft. 14. 620. 21. Diameter, 24 ft. 6in.; length, 9ft. 6in.; breadth, 3ft. 8in.; thickness, 4in.; number, 12. 22. Patent; modification of Morgau's Pateut. 23. About 22 tons. 24. 5ft. 2iu. 26. Maudsley, Sons, and Field's, Double Patent Cylinder. 27. $48\frac{1}{2}$ diameter. 28. No. 29. Four. 30. Two copper cylindrical, each $44\frac{1}{2}$ cubic feet. 31. Two, each 14 cubic feet. 32. Circular. 33. Not ascertained. 34. 25 revolutions. 35. Not ascertained. 37. 330·52. 38. 729·70 to 891·76; mean, 816·07. 39. $13\frac{1}{2}$ to 15. 40. 25 to $25\frac{1}{2}$. 41. Two. 42. Tubular. 43. *See* column 45. 44. Weight of boilers, 40 tons, 19 cwt., 1 qr., 20 lbs.; weight of water, 35 tous. 45. The boilers are now removed under which trials were made. The plans in the hands of the builders. 46. Twelve. 47. *See* column 45. 48. *See* column 45. 49. *See* column 45. 50. *See* column 45. 51. *See* colnmu 45. 52. Tubular. 53. *See* column 45. 54. Two 5ft. diameter. 55. Fifteen. 56. 5580 lbs.

RETURN OF PARTICULARS RESPECTING THE STEAM-SHIP "CAMBRIA," WHILST UNDER TRIAL.

1. Between Holyhead and Kingstown, six trips, 22nd to 26th May, 1856. 2. S. to E.; windy and fine; tides favourable. Three trips. 3. 2 tons, 19 cwt. 1 lb. 4. 13 tons, 14 cwt., 1 lb. 5. Not ascertained. 6. 806·36 to 1174·80. 7. Paddle. 8. *See* column 1. 9. *See* column 1. 10. 14·07. 11. 19 ft. 9 in. 12. 201 sq. ft., 10 in. 13. 8 ft. $10\frac{1}{2}$ in. 14. 840. 21. Diameter, 28 ft.; length, 7 ft.; breadth, 4 ft.; thickness, 4 in.; number, 16. 22. Ditto. 23. About 23 tons 10 cwt. 24. 5 ft. 10 in. 26. Side lever. 27. $73\frac{1}{2}$. 28. No. 29. Two. 30. Ordinary. 32. D. 33. Not ascertained. 34. 23 revolutious. 35. Not ascertained. 37. 392·10. 38. 806·36 to 1174·80; mean, 995·35. 39. $14\frac{1}{2}$ to $15\frac{1}{2}$. 40. $24\frac{1}{2}$ to 27. 41. Four. 42. Tubular. 43. *See* column 45. 44. Boilers, 66 tons; water, 60 tons. 45. The boilers are now removed under which trials were made. 46. Twclve. 52: Tubular. 54. Two; 5 ft. diameter. 55. Fifteen. 56. 5760 lbs.

RETURN OF PARTICULARS RESPECTING THE STEAM-SHIP "SCOTIA," WHILST UNDER TRIAL.

1. Between Holyhead and Kingstown, six trips, 17th to 21st May, 1855. 2. S. to N.E.; light winds and fine; tides partly unfavourable. 3. 2·17. 4. 13·10. 5. Not ascertained. 6. 861·84 to 1007·16. 7. Paddle. 8. *See* column 1. 9. *See* colmnn 1. 10. 15·68. 11. 192·7. 12. 188·78. 13. 8·10. 14. 680. 21. Diameter, 24 ft. 6 in.; length, 10 ft.; breadth, 3 ft. 8 in.; thickness, 3 in.; number, 12. 22. Pateut; modificatiou of Morgau's Patent. 23. About 23 tous. 24. 6 ft. 26. Maudsley, Sous, and Field's, Double Patent Cylinder. 27. 52. 28. No. 29. Four. 30. Two copper cylindrical, each 51 cube feet. 31. Two, each $16\frac{1}{2}$ cubic feet. 32. Circular. 33. Not ascertained. 34. 24 revolutions. 35. Not ascertained. 37. 379·92. 38. 861·814 to 1007·16; mean, 934·18. 39. 12 to $12\frac{1}{4}$. 40. $26\frac{1}{2}$ to 27. 31. Two. 42. Tubular. 44. Boilers, 47 tons, 3 cwt., 2 qr.; water, 39 tons. 45. The boilers are now removed uuder which trials were made. 46. Twelve. 52. Tubular. 54. Two, 5 ft. diameter. 55. Fifteen. 56. 6240 lbs.

RETURN OF PARTICULARS RESPECTING THE STEAM-SHIP "TELEGRAPH, WHILST UNDER TRIAL.

1. Between Holyhead and Kingstown, two trips, 29th May, 1857. 2. S.W.; moderate and fine; tides partly favourable. 3. 2 tons, 18 cwt. 4. 15 tons, 8 cwt. 5. Not ascertained. 6. 1165·98. 7. Paddle. 8. *See* column 1. 9. *See* column 1. 10. 15·24 statute miles. 11. 243 ft. 8 iu. 12. 224·70 sq. ft. 13. 9 ft. 8 in. 14. 1173. 21. Diameter, 26 ft. 10 in.; length, 10 ft.; breadth, 4 ft.; thickness, $3\frac{1}{2}$ in.; number, 14. 22. Patent; modification of Morgan's Pateut. 24. 4 ft. 5 in. 26. Side lever. 27. $77\frac{1}{4}$ diameter. 28. No. 29. Two. 30. Ordinary. 32. D. 33. Not ascertained. 34. 25 revolutions. 35. Not ascertained. 37. 448·0. 38. 1165·98. 39. Fourteen. 40. Twenty-six. 41. Two. 42. Tubular. 44. Boilers, 70 tous; water, 65 tons. 45. The boilers are uow removed under which trials were made. 46. Twelve. 47. Tube surface, 7382·76; furnace, 462·0; flame boxes, 747·0. 53. Number, 1128; length, 6 ft. 9 in.; diameter, $3\frac{3}{4}$ in. brass. 54. Two, 5 ft. diameter. 55. Fourteen. 56. 7800 lbs.

RETURN OF PARTICULARS RESPECTING THE STEAM-SHIP "MERSEY," WHILST UNDER TRIAL.

1. Stokes Bay, 21st April, 1859. 2. N.W. 4; smooth; ebb tide. 3. Not known. 4. Not kuown. 5. Not kuown. 6. 1088. 7. $30\frac{1}{4}$. 8. Mean, 2 runs, knots, 13·459. 9. Mean, 2 runs, knots, 13·117- 10. 13·288 knots. 11. Breadth, 254 ft. 5 in.; length, 30 ft. 12. 261. 13. 10 ft. 5 in. aft; 10 ft. 1in. forward. 14. 1300. 21. Diameter, 21 ft. 4 in.; length, 8 ft. 6 in.; breadth 3 ft. 5 in.; thickness, 3 in. 22. Featheriug. 23. $13\frac{1}{2}$ tons. 24. 4 ft. 25. Not tried. 26. Oscillating. 27. 60 in. diam.; length of stroke, 5 ft. 28. Steam

belt. 29. Two. 30. Ordinary. 31. Ordinary bucket pump. 32. India rubber valves. 33. 81 tons. 34. 302½ feet, 30¼ revolutions. 35. Unknown. 37. 250. 38. 1088. 39. 20 lbs. full. 40. Per Maudsley's foreman, Condenser, 25½ in.; but 26 starboard and 26½ port engines, by our engineers. 41. Four. 42. Tubular. 43. 8 ft. 2 in. by 10 ft. 6 in.; 13 ft. 6 in. high. 44. 75 tons without, 120 with. 45. 1125 steam room, 1620 water room. 46. Eight. 47. 178 ft. grate surface, 4400 tube surface, 1007 other surface. 48. 528 cubic ft. 49. 1 ft. 2 in. at front, 2 ft. 6 in. at back. 50. 2 ft. 2 in. at front. 51. 30 sq. ft. 53. 864 brass tubes, 3 in. diameter, 6 ft. 6 in. long. 54. 2 chimnies 4 ft. diameter. 55. 20 lbs. 56. Not tried. — (Signed) H. V. Strutt, Examiner R.M.S.P. Co.

Return of Particulars respecting the Steam-ship "Parramatta," whilst under Trial.

1. 7th June, 1859. 2. Variable; moderate. 3. Unknown. 6. 2940. 7. Paddle wheels. 8. 14·008 knots. 9. 13·907. 10. 13·957. 11. Length, 329·5; breadth, 43·75. 12. 606·2 sq. ft. 14. 3862. 15. Centre of gravity of displacement, 3 ft. abaft middle of load line, and 8·41 ft. below. 21. Diameter, 38 ft. 6 in. over floats; ditto, 34 ft. 3½ in. at axis; floats, 12 ft. by 4 ft. 6 in. by 5 in.; 15 floats on each wheel. 22. Feathering. 23. 69 tons. 24. 6 ft. 8 in. 25. Not tried. 26. Double cylinder. 27. Diameter, 68⅛ in. 28. No. 29. Four. 30. Ordinary. 31. Ordinary. 32. Conical valves. 33. 291 tons. 34. 17 revolutions per. mi. 35. Not tried. 37. 764. 38. 2940. 39. 17½ lbs. guage on boiler. 40. 26 in. vac. 41. Four. 42. Tubular. 43. Length, 24 ft. 9 in.; height, 21 ft. 11 in. 44. Boilers, 220 tons; water, 184. 45. Steam-room, 5292 cu. ft.; water-room, 6440. 46. Twenty-four. 47. Grate, 7 ft. by 3 ft. 6½ in.; by 24in. tubes, 14696 sq. ft.; furnaces, &c., 2564 sq. ft. 48. 2636 ft. in 4 boilers. 49. 2 ft. 50. 2 ft. 6 in. 51. 127 sq. ft. in the 4 boilers. 53. 2496 brass tubes; internal diameter, 3¼ in.: external diameter, 3½ in. 54. Two, 42 ft. long, 6 ft. 8 in. diameter. 55. 17 lbs. 56. Unknown.—H. V. Strutt, R.M.S.P. Co. Examiners.

Return of Particulars respecting the Steam-ship "Lima," whilst under Trial.

1. From Liverpool to Kingstown and back, May 20th, 1859. 2. Fresh breeze, northerly. 3. 3 tons. 4. 11 tons 5 cwt. 5. 270,000 lbs. 6. 1160. 8. 13½. 9. 12¼. 10. 12. 11. L. on deck, 257 ft.; length between perpen., 251 ft.; breadth, 10ft.; depth of hold, 17 ft.; depth to spar deck, 25 ft. 4 in. 12. 302. 13. For. 11 ft. aft, 12 ft. 14. 1345. 21. Diameter, 26 ft. over all; do., 25 ft. 2 in. over floats; floats, 8 ft. 2 in. long, 3 ft. broad, ⅝ in. th ick. 22. Feathering. 23. 20 tons. 24. 4 ft. 26. Randolph & Elder's patent double cylinder engines. 27. High pressure cylinder, 52 in.; low pressure do. 90in. 28. Yes. 29. Four. 30. Common. 31. 17 ft. 32. Short slide, 24 in. by 6 in. 33. 200 tons. 34. 240 ft. 35. 100°. 37. 320. 38 1150. 39. 24 lbs. 40. 28 lbs. 41. Two. 42. Tubular, superheated, 400° Far. 43. 12ft. by 10ft. 44. Boilers, 50 tons; with water, 68 tons. 45. 1000 cub. ft. 46. Six. 47. Grate, 136; steam, 1700; heating, including uptakes, 1500. 48. 480 ft. 49. 2ft. 50. 2ft. 6in. 51. About 50ft. 53. 258 iron tubes, 4in. internal, 4¼in. external. 54. One, 5ft. diameter. 55. 27cwt. 56. 25.

Return of Particulars respecting the Steam-Ship "Admiral," whilst under Trial.

1. Between the Cloch and Cumbrae Lighthouses, Frith of Clyde, distance 13·66 knots. 11th June, 1858. 2. Tide, quarter ebb, favourable for, 13·66 knots; half ebb, adverse for, 13·66 knots. 4. 2206 lbs. per hour for 3¼ hours. 6. 744. 7. Paddles, 3303 in 2·305 hours. 8. 12·65 knots, or 14·55 miles. 9. 11·15 knots or 12·82 miles. 10. 11·9 knots, or 13·69 miles. 11. 210 by 32. 12. 214 square ft. 13. 7 ft. 6 in., both. 14. 820 tons. 21. Diameter to Journals. 20ft. 6in.; 11 floats, 7ft. long, 3ft. broad, and ⅝ thick. 22. Feathering. 26. Double Cylinder. 27. Large, 4ft. 3in. stroke, 76½in. diameter; Small, 4ft. 3in. stroke, 48½in. diameter. 28. Steam-jacketed. 29. Four. 33. Engine and Boilers, 210 tons. 34. 24 roevolutions. 38. 744. 39. Average, Boiler, 25 lbs., Cylinder, 19 lbs. 44. *See* Column 33. 47. Grate, about 100. 56. 2206 lbs.—Certified by W. J. Macquorn Rankine.

Return of Particulars respecting the Steam-ship "Emerald," whilst under Trial.

1. Ayr Bay, July, 21, 1859. 2. Still water, light airs. 3. 30 cwt. 4. 13½ cwt. 5. Not known. 7. 80 per minute. 8. 12 miles. 9. No tide. 10. 12 statute or 10$\frac{5}{11}$ knots. 13. 10ft forward and same aft. 14. 150. 16. Diameter, 9ft.; 3-blade; pitch, 14ft; area of blade, 20ft. 17. 18in. 18. 33cwt. 19. Not known. 20. Not known. 26. Horizontal. 27. Length of stroke, 22in.; diameter, 28 in. 28. No. 29. Two. 30. Common condenser, contents not known. 31. Trunk, 3476 cubic inches. 32. Common slide valve. Area not known. 33. Not known. 34. 293⅓. 35. 95 degrees. 36. 56ft. 37. Eighty. 38. Not known. 39. Not known. 40. Vacuum in condenser, 23½in. 41. One. 42. Tubular. 43. Depth, 11ft.; length, 9½ft.; breadth, 13½ 34. Not ascertained. 45. Not known. 46. Four. 47. 1313ft. 48. 198ft. 49. At door, 19in.; at back, 26in. 50. At front, 26in.; at back, 19in.; mean, 22½. 51. 17$\frac{1}{12}$. 52. Boiler tubular. 53. 270 iron, tubes, 6½ft. long; exterior diameter, 3⅛; interior, 2⅝. 54. One, 26ft. by 4ft. diameter. 55. 13½lbs. 56. 13½cwt.

APPENDIX VII.—Table 1.

Result of Experiments with the Yacht *Undine*, July 6th, 1858, on the measured mile at Greenhithe.

Immersion of periphery, 1ft, 8in. Displacement, 294 tons.

Diameter of cylinder, 24in, Diameter of screw, 7ft 10in. Draught of water, 8ft. 6in. forward, 11ft. aft.

Length of stroke, 15in. Pitch, 11ft 3in.; length, 1ft 4in. Midsection, 154·33 sq. ft.

Number of Diagram.	Steam in Boiler per Square Inch.*	Average through Stroke pr Sq. Inch.	Vacuum through Stroke pr Sq. Inch.	Total effective Pressure per Sq. Inch.	Number of Revolutions per Minute.	Number of Revolutions per Trip.	Time of performing Trip.	Horse Power exerted.	Rate in Statute Miles per Hour. Ship.	Rate in Statute Miles per Hour. Screw.	Rate in Nautical Miles per Hour. Ship.	Rate in Nautical Miles per Hour. Screw.	Speed in Feet Per Minute. Ship.	Speed in Feet Per Minute. Screw.	Per cent of Slip of Screw.	Remarks. Wind, Tide, &c.
No.	lbs	lbs.	lbs.	lbs.			m. s.									
2a	13.	9·8	10·23	20·03	95·89	561.	5 51	131·64	11·8	12·26	10·24	10·64	1039·2	1078·78	3·68	With good ebb tide and calm.
2b	13.	9·8	10·23	20·03												
3a	15.	10·55	10·63	21·10	98·61	807·	8 11	146·32	8·44	12·6	7·32	10·94	742·8	1109·4	33·14	Against tide, above 2 knots and
3b	15.	11·56	10·59	22·12												No. 3 wind.
4a	17.	13·16	10·33	23·49	104·5	580·	5 33	172·04	12·45	13·36	10·8	11·26	1095·6	1175·4	6·79	With tide and wind astern.
4b	17.	14·	10·56	24·56												
5a	16.25	12·43	11·43	23·86	100·65	770·	7 39	162·58	9·03	12·86	7·84	11·16	795·0	1132·2	29·79	Against tide, same wind as pre-
5b	16·25	12.16	11·16	23·32												vious trial (hardly so strong.)
6a	16·5	12·93	10·76	23·69	105·08	606·	5 46	165·2	11·9	13·43	10·39	11·65	1054·2	1182·	10·82	With tide, but nearly low water.
6b	16·5	12·9	10·3	23·20												Scarcely any wind.
7a	17·	13·93	10·63	24·56	103·72	714·	6 53	162.32	10·03	13·25	8·71	11·34	883·2	1166·4	24·28	Against tide. Nearly, if not low
7b	17·	13·06	10·86	23·92												water. Wind ahead.
8a	15·75	11·6	10·6	22·2	103·72	650·	6 16	159·58	10·99	13·25	9·54	11·34	967·2	1166·4	17·08	About low water. Wind slight
8b	15·75	11·66	11·03	22·69												astern.
Average of the whole	15.8	12·29	10·70	22·98	101·74	669·71	6 35	157·09	10·66	13·00	9·26	11·29	939·6	1144·575	18·0	
Average 4a to 8b	16·41	12·88	10·75	23·54	103·53	664·00	6 25	164·32	11·02	13·34	9·45	11·35	959·0	1184·55	17·75	
Mem. of Performance on Trial, July 19, 1856.					mean. 108			mean. 162.	9·92	13·5	8.6	11·69	872·96	11·88	26·25	Diameter, 6ft. 6in.; Pitch, 11ft.; Length, 1ft. 4in.; Draught forward, 8ft. 3in.; Draught aft, 11ft. 3in.; Midsection, 148sq. ft.

* For Mean Speed, see page 351.

APPENDIX VII. Continued.—Table 2.

Result of Experiments with the Yacht *Undine*. July 29th and 30th, 1858.

Immersion of Periphery, 1 ft. 8 in.
3*a* Grade.
Cylinder filled nearly $\frac{3}{4}a$. Cut off $\frac{1}{2}a$.

Diameter of Cylinder, 24 inches.
Diameter of Screw 7 ft. 10 in.
Draft of water forward, 8ft. 6in.

Stroke, 15 inches.
Pitch, 11 ft. 3 in. Length, 1 ft. 4 in.
Aft, 11 ft. 10 in. Midsection, 154·33 sq. ft.

Portion of Trip.	No. of Diagram.	Hour when diagram was taken.	Steam in Boiler per square inch.	Average pressure through stroke per square inch.	Vacuum through stroke per square inch.	Total effective pressure per square inch.	No. of revolutions per minute.	Horse-power exerted.	Consumption of fuel.		Per Cent. of slip of screw.	Rate in statute miles per hour.		Rate in nautical miles per hour.		Speed in feet per minute.		Remarks.
									Per hour.	H. P. per hour		Ship.	Screw.	Ship.	Screw.	Ship.	Screw.	
	No.		lbs.	lbs.														
Holyhead to Calf of Man.	1*a*	6.30 A.M.	16·0	13·86	11·53	25·39	94·0	154·13				55 miles in 5 hrs. 30 min. or 10·9 miles per hour.	12·01		10·4		1057·5	Wind slight ahead.
	1*b*			11·73	10·73	22·46												Tide against vessel.
	2*a*	7.30 „	14·5	11·66	11·07	21·86	101.0	150·39					12·91		12·0		1136·25	Set jib and foresail.
	2*b*			10·73	11·13	25·13												Wind shifted more easterly.
	3*a*	9.0 „	14·75	12·8	12·33	25·13	100·2	167·76			13.6		12.80	9·4	11·1	959·2	1127·5	More sail set.
	3*b*			12 2	11·53	23·73												Tide strong ebb with vessel.
	4*a*	10.30 „	16·0	12·6	11·63	24·23	99·3	160·84					12·69		11·08		1116·02	
	4*b*			12·0	10·6	22·6												All sail set except mainsail.
	5*a*	11.30 „	14·75	12·6	11·66	24·26	100·4	169·0					12·83		11·1		1129·5	
	5*b*			13·6	11·3	24·9												
Average . .			15·2	12·37	11·35	23·96	98·98	160·42			13·6	10·9	12·64	9·4	11·13	959·2	1109·35	
Calf of Man to Port Patrick.	6*a*	12.0 noon.	15.5	13·13	11·46	24·59	99·0	163·8				52 miles in 4h. 30 min. or 11·55 miles.	12.67		11·08		1113·75	Tide strong with vessel.
	6*b*			11·1	11·4	22·5												Wind brisk.
	7*a*	1.0 P.M.	17.5	11·74	11·6	23·34	105·0	155·4			10·94		13·14	100·2	11·6	1012	1181·25	Wind falling off.
	7*b*			12·06	11·86	23·83												Took in sail.
	8*a*	3.30 „	15·0	12·46	10·8	23·26	99·0	161·12					12·67		11·08		1113·75	Sea smooth—wind slight.
	8*b*			10·9	11·56	22·46												
Average . .			16·0	11·89	11·44	23·33	101·0	160·10			10·94	11·55	12·82	100·2	11·25	1012	1136·25	
Port Patrick to the Mull of Cantyre.	9*a*	4.0 P.M.	16·0	12·16	11·67	23·83	102·0	166·9	3 tons of coal consumed in 12 hours, exclusive of raising steam.				13·04		11·3		1147·5	Jib and foresail set.
	9*b*			13·66	11·32	24·98												Sea calm.
	10*a*	4.30 „	14·5	10·9	10·03	20·93	97·0	150·6					12·40		10·7		1091·25	Wind slight.
	10*b*			12·0	11·46	23·46					3·18	12·1		10·5		1064·8		Sea calm.
	11*a*	5.0 „	14·75	13·07	11·11	24·18	98·0	164·4					12·5		10·8		1102·5	Wind slight in favour.
	11*b*			12·73	11·4	24·13												Jib and foresail set.
	12*a*	6.0 „	14·5	11·0	11·53	22·53	94·0	152·6					12·01		10·4		1057·5	Sea calm.
	12*b*			11·26	11·6	22·56												Wind slight.
Average . .			14·93	12·09	11·27	23·33	95·25	155·8	560·0	3·52	3·18	12·1	12·48	10·5	10.8	1064·8	1099·68	
	Mean	Performance	15·37	12·11	11·35	23·54	98·40	158·77	560·0	3·52	9·24	11·5	12·64	9.97	11·06	1012·0	1115·09	

APPENDIX VII. *Continued.—Table* 3.

Result of Experiments with the Yacht *Undine*. October 26th, 27th, and 28th, 1858.

Immersion of Periphery, 1ft. 8in.
Bottom foul.

Diameter of Cylinder, 24 inches.
Diameter of Screw, 7 feet 10 inches.
Draft of Water, 8ft. 6in. forward, 11ft. 10in. aft.

Length of Stroke, 15 inches.
Pitch, 11 feet 3 inches. Length, 1 ft. 4 inches.
Midsection, 154·33 sq. ft.

Portion of Trip.	Hour when diagram was taken.	Steam in Boiler per square inch.	Average pressure through stroke per square inch.	Vacuum through stroke per square inch.	Total effective pressure per square inch.	No. of revolutions	Horse-power exerted.	Per Cent. of slip of screw.	Rate in statute miles per hour.		Rate in nautical miles per hour.		Speed in feet per minute.		Remarks.
									Ship.	Screw.	Ship.	Screw.	Ship.	Screw.	
	26th.	lbs.	lbs.	lbs.	lbs.										
Loch Ness		16·5	14·8	11·46	26·26	96·35	173·42	45·61	6·7	12·31	5·81	10·69	589·6	1083·93	Head wind strong all the way to Fort Augustus. 22 miles by Chart.
Loch Ness		16·5	14·96	11·56	26·52	96·35	175·14	45·61	6·7	12·31	5·81	10·69	589·6	1083·93	
Loch Ness		18·0	15·06	12·06	27·12	96·35	179·1	45·61	6·7	12·31	5·81	10·69	589·6	1083·93	
		17·0	14·70	11·69	26·63	96·35	175·88	45·61	6·7	12·31	5·81	10·69	589·6	1083·93	
Loch Lochy	27th. 2 P.M.	17·0	11·1	12·13	23·23	99·07	157·68	30·29	8·83	12·66	7·66	10·99	777·04	1114·53	Fair. No sails. Wind slight. 10 nautical miles by Chart.
Loch Lochy		17·0	11·2	12·16	23·36	99·07	161·46	30·29	8·83	12·66	7·66	10·99	777·04	1114·53	
Loch Lochy		17·5	11·13	11·51	22·64	99·07	153·6	30·29	8·83	12·66	7·66	10·99	777·04	1114·53	
		17·1	11·14	11·93	23·07	99·07	157·58	30·29	8·83	12·66	7·66	10·99	777·04	1114·53	
Sound of Jura	28th. 6 P.M.	15·5	8·76	11·6	20·36	99·065	138·2	−2·02	12·92	12·66	11·22	10·99	1136·96	1114·25	Fair wind and with tide. All available sail set until near the Mull, when wind fell off, and also more abeam; rough near the Mull. Cross tide. 100 nautical miles.
Sound of Jura		15·5	9·46	12·36	21·82	99·065	148·16	−2·02	12·92	12·66	11·22	10·99	1136·96	1114·25	
		15·5	9·11	11·98	21·9	99·065	143·18	−2·02	12·92	12·66	11·22	10·99	1136·96	1114·25	
General Average ...		16·9	12·06	11·85	23·9	98·047	160·84	36·94	9·48	12.54	8·23	10·93	801·2	1104·23	
Average of Experiments, July 29 and 30th, Holyhead to Mull of Cantyre		15·37	12·11	11·35	23·54	98·40	158·77	9·24	11·5	12·64	9·97	11·06	1012	1115·09	

APPENDIX VII. *Continued.—Table* 4.

Experiments with Yacht *Erminia*, 12th October, 1858, in Stokes Bay.

Draft forward, 9ft. 3 in.
Do. aft., 12ft. 11in.

Immersion of periphery. 2ft 6 in.
Area of midsection, 149·18 sq. ft.

Diameter of Cylinder, 15in.
Diameter of Screw, 8ft.

Stroke, 18 in.
Pitch, 13ft.

No. of Diagram.	Steam in Boiler.	Average through Stroke.	No. of Revolutions Per mile.	No. of Revolutions per minute.	Horse Power exerted.	Per cent. of Slip of Screw.	Rate in stat. miles per hour.		Rate in Naut. miles per hour.		Speed in feet per minute		Remarks.
							Ship.	Screw.	Ship.	Screw.	Ship.	Screw.	
	lbs.	lbs.											
1 2	53 53	36·2 32·7	743	54·03	59·98	37.1	4·95	7·98	4·36	6·92	442·4	702·39	Against wind and tide.
3 4	53 53	28·7 29·3	416	51·8	48·26	10·8	8·62	7·65	7·44	6·64	754·4	673·4	With wind and tide.
5 6	50 53	34·16 32·0	615	53·4	58·68	23·86	5·91	7·88	5·21	6·84	528·6	694.2	Against wind and tide.
7 8	50 50	32·77 30·94	440	50·28	51·44	6·2	7·87	7·42	6·85	6·44	695·1	653·64	With wind and tide.

Continuation of Table 1, *Appendix* 7.

FOR MEAN SPEED.

Nautical Miles of Ship.	Difference.	Half Difference.	True Speed.
10·24			
7·32	2·92	1·46	8·78
10·8	3·48	1·74	9·06
7·84	2·96	1·48	9·32
10·39	2·55	1·27	9·11
8·71	1·68	0·84	9·55
9·54	0·83	0·41	9·12
7)64·84			6)54·94
9·26			9·156
20·8			
7.84	2·96	1·48	9·32
10.39	2·55	1·27	9·11
8·71	1·68	1·84	9·55
4)37.74			3)27·98
9.43			9.326

MERCANTILE STEAM TRANSPORT ECONOMY AS AFFECTED BY THE CONSUMPTION OF FUEL.

By Charles Atherton, Chief Engineer, Royal Dockyard, Woolwich.

Public usefulness, as dependent upon science, being the great object for which the "British Association for the Advancement of Science" was originated, and has now been signally upheld for 29 years, a period remarkable for the progress that has been made in the utilisation of the powers of uatnre, to such an extent that the international condition of the globe is now being revolutionized by the progressive practical utilisation of elements which heretofore were regarded merely as phenomena of nature, viz:—Steam and Electricity; in which revolution the application of steam to the purposes of navigation has played so conspicuous a part, that now, in proportion as steam may be effectively employed in the pursuits of commerce and of war, it is acknowledged that even nations will rise or fall. Seeing, moreover, that at uo period iu the history of steam navigation has so great a step been made in its practical development as may now be said to have been realized by the fearless introduction, in marine engineering, of the long known and well understood effects of increased pressure, superheating, and expansion; the recognition and application of which principles has now, at length, been atteuded with such effect in marine engineering, that the consumption of fuel with reference to power is now shown to be practically reduceable to less than one-half of the ordinary consumption of coal on board ship. Seeing also that mercantile enterprise, setting no limits to speculative investments, has in these days emancipated mechanical intellcct from the fetters by which ideas as respects magnitude have hitherto been bound. Under such circumstances I cannot doubt that any effort to popularise a knowledge of the practical utilisation of steam, with reference to the consumption of fuel, though advanced with no pretentions to science, beyond that which may be awarded to originality, and labour in the application of calculation to developing useful results, will be favourably received, more especially as the paper which I now beg to present is in continnation and conclusion of an enquiry, which has already, in part, on two occasions, been favourably entertained by this Association, and honoured with a place in its published records. The former papers to which I allude are:—1st. "Mercantile Steam Transport Economy, with reference to Speed."—Vol. for 1856, p. 423. 2nd. "Mercantile Steam Transport Economy, with reference to the Magnitude of Ships, and their Proportions of Build."—Vol. for 1857, p. 112. And I now purpose to bring this enquiry to its conclusion by the following paper on

E.

Diagram showing approximately the Nautical Mileage Consumption of Fuel, for Vessels from 1,000 tons displacement, up to 25,000 tons, the Co-efficients of Dynamic Performance deduced from the Formula $\frac{\sqrt[3]{D^2} \cdot \ldots}{\text{Ind. H. P.}}$ being assumed to be 250, and the Consumption of Coals being assumed to be at the rate of $2\frac{1}{2}$ lbs. per Ind. H. P. per hour.

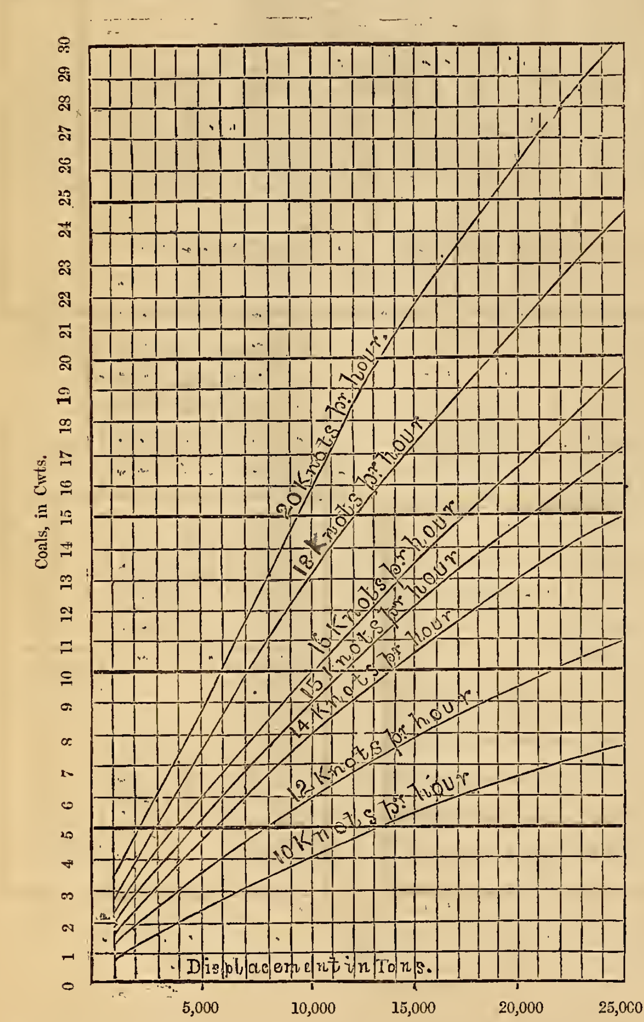


TABLE C.

Calculated for the Speed of 10 knots per hour, and showing the mutual relations of Displacement, Power, and the Consumption of Coal, per Day, Hour, and Knot, the Coefficients of Dynamic performance, deduced from the Formula $\frac{\sqrt[3]{d^2}\ \ldots}{\text{ind h. p.,}}$ being assumed to be 250, and the consumtion of fuel at the rate of $2\frac{1}{2}$lbs. per ind. h.p. per hour.

Displacement.	Nominal H.P. taken at the unit 100,000 lbs. 1ft. per min.	Indicated H.P. taken at the unit 33,000 lbs. 1ft. per min.	Coals.		
			Per Day of 24 hours.	Per Hour.	Per Knot.
Tons.	H.P.	Ind H.P.	Tons.	Cwt.	Cwt.
250	52	159	4·26	3·55	·36
300	59	179	4·80	4·00	·40
350	66	199	5·33	4·44	·44
400	72	217	5·81	4·84	·48
450	78	235	6·30	5·25	·53
500	83	252	6·74	5·62	·56
600	94	285	7·63	6·36	·64
700	104	315	8·44	7·03	·70
800	114	345	9·24	7·70	·77
900	123	373	9·98	8·32	·83
1,000	132	400	10·70	8·92	·89
1,100	141	426	11·4	9·51	·95
1,200	149	452	12·1	10·1	1·01
1,300	157	476	12·7	10·6	1·06
1,400	165	501	13·4	11·2	1·12
1,500	173	524	14·0	11·7	1·17
1,600	181	547	14·6	12·2	1·22
1,700	188	570	15·4	12·8	1·28
1,800	195	592	15·8	13·2	1·32
1,900	203	614	16·4	13·7	1·37
2,000	210	635	17·0	14·2	1·42
2,250	227	687	18·4	15·3	1·53
2,500	243	737	19·7	16·4	1·64
2,750	259	785	21·0	17·5	1·75
3,000	275	832	22·3	18·6	1·86
3,250	290	878	23·5	19·6	1·96
3,500	304	922	24·7	20·6	2·06
3,750	318	965	25·8	21·5	2·15
4,000	333	1008	27·0	22·5	2·25
4,250	347	1050	28·1	23·4	2·34
4,500	360	1090	29·2	24·3	2·43
4,750	373	1133	30·2	25·2	2·52
5,000	386	1170	31·3	26·1	2·61
5,500	411	1246	33·4	27·8	2·78
6,000	436	1321	35·4	29·5	2·95
6,530	460	1393	37·3	31·1	3·11
7,000	483	1464	39·2	32·7	3·27
7,500	506	1533	41·0	34·2	3·42
8,000	528	1600	42·8	35·7	3·57
8,500	550	1666	44·6	37·2	3.72
9,000	571	1731	46·3	38·6	3·86
9,500	592	1794	48·0	40·0	4·80
10,000	613	1857	49·7	41·4	4·14
11,000	653	1978	52·9	44·1	4·41
12,000	692	2096	56·2	46·8	4·68
13,000	730	2211	59·2	49·3	4·93
14,000	767	2324	62·3	51·9	5·19
15,000	803	2433	65·2	54·3	5·43
20,000	973	2498	79·0	65·8	6·58
25,000	1129	3420	91·6	76·3	7·63

Mercantile Steam Transport Economy, as affected by the Consumption of Coals.

My purpose, and the drift of my remarks will, probably, be the more readily understood by my at once adducing the following tables C and D, and the diagram E, in continuation of the tables A and B, which are published in the Volume of Transactions for the year 1857, pp, 116 and 119, observing with reference to these tables C and D, that the rate of consumption of coal on which the calculations are based, viz:—2½lbs. per indicated horse power per hour has been practically realized on continuous sea service, although the ordinary consumption of steam-ships in the Royal Navy, as well as in the best vessels of the most celebrated steam shipping companies, is, I believe, at the present time, fully 50 per cent. in excess of that amount; and I may say, that in steam shipping generally, the consumption of coals per knot of distance, with respect to displacement and speed, is double the consumption which these tables, based as they are on an example of existing practice, show to be now practically realisable.

TABLE D.

Showing the Mutual Relations of Displacement, Power, and Coals consumed per Day, per Hour, and per Knot, for the respective Speeds of 10, 15, 20, and 25 Knot per Hour. The Coefficient of Dynamic Performance being deduced from the Formula $\frac{\sqrt[3]{d^2} \cdot }{\text{ind. h. p}}$ being assumed to be 250, and the Consumption of Coals being assumed to be at the rate of 2½lbs per indicated horse power per hour.

Displacement in Tons, at 35 cubic feet of Sea Water per Ton.	10 Knots.				15 Knots.				25 Knots.				25 Knots.			
	Ind. H. P.	Coals.			Ind. H. P.	Coals.			Ind. H. P.	Coals.			Ind. H. P.	Coals.		
		Per Day.	Pr Hour.	Pr Knot.		Per Day.	Pr Hour.	Pr Knot.		Per Day.	Pr Hour.	Pr Knot.		Per Dap.	Pr Hour.	Pr Knot.
		Tons.	Tons.	Cwt.		Tons.	Cwt.	Cwt.		Tons.	Cwt.	Cwt.		Tons.	Cwt.	Cwt.
1,000	400	10·7	8·92	·89	1350	36·1	30·1	2·0	3200	85·7	71·4	3·57	6250	167	139	5·56
1,200	452	12·1	10·1	1·01	1524	40·8	34·0	2·27	3614	96·8	80·7	4·03	7058	188	157	6·28
1,400	501	13·4	11·2	1·12	1689	45·2	37·7	2·51	4005	107	89·4	4·47	7822	210	175	7·00
1,600	547	14·6	12·2	1·22	1847	49·4	41·2	2·75	4377	117	97·7	4·88	8550	229	191	7·64
1,800	592	15·8	13·2	1·32	1998	53·5	44·6	2·98	4735	126	105	5·25	9248	247	206	8·24
2,000	635	17·0	14·2	1·42	2143	57·4	47·8	3·19	5080	136	113	5·65	9921	265	221	8·84
2,250	687	18·4	15·3	1·53	2318	61·8	51·5	3·43	5495	146	122	6·10	10,731	286	239	9·56
2,500	737	19·7	16·4	1·64	2487	66·6	55·5	3·70	5895	158	132	6·60	11,629	308	257	10·3
2,750	785	22·0	17·5	1·75	2650	70·9	59·1	3·94	6281	168	140	7·00	12,268	328	273	10·9
3,000	832	21·3	18·6	1·86	2808	75·2	62·7	4·18	6656	178	148	7·40	13,000	348	290	11·6
3,250	878	23·5	19·6	1·96	2962	79·3	66·1	4·40	7021	188	157	7·85	13,715	367	306	12·2
3,500	922	24·7	20·6	2·06	3112	83·3	69·4	4·63	7377	197	164	8·20	14,408	385	321	12·8
3,750	965	25·8	21·5	2·15	3259	87·2	72·7	4·85	7724	206	172	8·69	15,086	404	337	13·5
4,000	1008	27·0	22·5	2·25	3402	91·1	75·9	5·06	8064	216	180	9·00	15,749	421	351	14·0
4,250	1050	28·1	23·4	2·34	3542	94·9	79·1	5·27	8396	224	187	9·35	16,392	439	366	14·6
4,500	1090	29·2	24·3	2·43	3680	98·5	82·1	5·47	8722	233	194	9·70	17,036	456	380	15·2
4,750	1130	30·2	25·2	2·52	3815	102	85·1	5·67	9042	240	202	10·1	17,661	473	394	15·8
5,000	1170	31·3	26·1	2·61	3947	106	88.1	5·87	9357	251	209	10·4	18,215	488	407	16·3
6,000	1321	35·4	29·5	2·95	4458	120	100	6·67	10,566	283	236	11·8	20,637	553	461	18·4
7,000	1464	39·2	32·7	3·27	4940	132	110	7·33	11,710	313	261	13·0	22,870	612	510	20·4
8,000	1600	42·8	35·7	3·57	5400	145	121	8·01	12,800	342	285	14·2	25,000	670	558	22·3
9,000	1731	46·3	38·6	3·86	5841	156	130	8·67	13,846	371	309	15·4	27,042	724	603	24·1
10,000	1857	49·7	41·4	4·14	6266	167	139	9·27	14,853	398	332	16·6	29,010	778	648	25·5
12,000	2096	56·2	46·8	4·68	7076	190	158	10·5	16,772	449	374	18·7	36,760	877	731	29·2
14,000	2324	62·3	51·9	5·19	7842	210	175	11·7	18,588	498	415	20·7	46,305	972	810	32·4
16,000	2540	68·0	56·7	5·67	8572	229	191	12·7	20,320	544	453	22·6	39,684	1063	886	35·4
18,000	2748	73·6	61·3	6·13	9272	448	207	13·8	21,980	589	491	24·5	42,294	1150	958	38·3
20,000	2948	79·0	65·8	6·58	9948	266	222	14·8	23,580	631	526	26·3	46,048	1233	1028	41·1
22,000	3140	84·0	70·0	7·00	10,600	283	236	15·7	25,124	673	561	28·0	49,072	1314	1095	43·8
25,000	3420	91·6	76·3	7·63	11,542	310	258	17·2	27,359	733	611	30·5	53,436	1432	1193	47·7

The Tables now adduced are as follow:—

Table C, calculated for the speed of 10 knots per hour, showing the mutual relations of displacement, power, and the consumption of coals *per day, per hour, and per knot*, for vessels of a gradation of sizes, from 250 tons displacement up to 25,000 tons, the co-efficient of dynamic performance, deduced from the Formula $\frac{\sqrt[3]{d^{\frac{2}{3}}}}{\text{ind. h.p.}}$ being assumed to be 250, and the consumption of coals being assumed to be at the rate of 2½ lbs. per indicated h. p. per hour. On these data, the co-efficient with reference to coals deduced from the Formula $\frac{\sqrt[3]{d^{\frac{2}{3}}}}{w}$ (w being the consumption of coals per hour expressed in cwts.) becomes 11.210.

Table D, showing the mutual relation of displacemeet power and coals consumed *per day, per hour*, and *per knot* for the respective speeds of 10, 15, 20, and 25 knots per hour. The data on which this table is calculated being the same as above described for Table C.

Diagram E, showing approximately by scale the nautical mileage consumption of coals for vessels from 1,000 tons displacement up to 25.000 tons, deduced from Table D.

It will be observed that in Table C the tabulated sizes of ships, as determined by their respective load displacements, increase progressively from 250 tons displacement up to 25,000 tons, showing under assumed conditions, which, however, are justified by the present circumstances of realized advancement in steam navigation, the mutual relations of displacement and coals calculated for the speed of 10 knots per hour as most convenient for a standard of reference. The intended practical use of this Table C is to facilitate mercantile investigation into the dynamic merits of steam-ships as locomotive implements of burden by comparing their actual consumption of fuel with the calculated consumption of the ship of corresponding size and speed as recorded in this tabulated standard of comparison, wheuce the constructive merit of ships, as respects their *working economy of fuel, on which the cost of freight so much depends*, may be relatively ascertained. For example, a certain ship of 800 tons mean displacement attains the speed of 8.8 knots per hour, with a consumption of coals certainly not exceeding 4·3 cwts. per hour, or ·49 cwts. per nautical mile or knot; which (as the consumption of coals per knot varies *cœteris paribus* as the square of the speed) is equivalent to ·63 cwts. per knot at the speed of 10 knots per hour. Now by referring to Table D. we find that on the assumed data therein referred to the standard ship of 800 tons displacement, steaming at 10 knots per hour would consume ·77 cwts. of coal per knot. Hence, therefore, it appears that the ship referred to in this instance is *superior* to the tabulated standard in the proportion of ·77 to ·63, that is, in the proportion of 122 to 100, the superiority with reference to the consumption of coals per knot being 22 per cent.

Again, a certain ship of 3,500 tons mean sea displacement makes a voyage at the average speed of 12·88 knots per hour, consuming 83 cwts. of coal per hour, or 6·44 cwts. per knot, which, by the law of dynamics above quoted, is equivalent to 3·88 cwts. per knot at the speed of 10 knots per hour; but by referring to the Table of comparison C, we find that the standard ship of 3,500 tons displacement, steaming at 10 knots per hour, would consume only 2·06 cwts. of coal per knot. Hence, therefore, it appears that the ship referred to in this instance is *inferior* to the tabulated standard ship in the proportion of 2·06 to 3·88, that is, in the proportion of 53 to 100, the inferiority with reference to the consumption of coals being 47 per cent.

Thus, by reference to this tabulated standard of comparison (C), we have the means of readily deducing the exact per centage by which ships, as respects the dynamic duty performed with reference to the consumption of coals, differ from each other. I need not dwell on the importance of this consideration as affecting the commercial value of ships.

With reference to Table D, showing the mutual relations of displacement, power, and coals consumed per day, per hour, and per knot for the respective speeds of 10, 15, 20, and 25 knots per hours, the object of this table is to show the extent to which the required engine-power, and the nautical mileage consumption of coals are dependant on the rate of speed, thereby facilitating the adaptation of ships as respects their size and power to the service that may be required of them.

For example, by referring to Table D, we observe that a ship of 5,000 tons displacement, steaming at 10 knots per hour, requires 1,170 indicated h. p., and consumes 2·61 cwts. of coal per knot; but to steam 15 knots per hour, the same vessel would require 3,947 ind. h. p., and the consumption of coals would be 5·87 cwts. per knot; hence it appears, that to increase the speed from 10 to 15 knots per hour, the power requires to be increased upwards of three times, and the consumption of coals per knot is more than doubled.

Again, let it be supposed that the weight of the hull of a ship of 5,000 tons displacement fitted for sea amounts to 40 per cent. of the displacement, or 2,000 tons, and suppose the weight of the engines and boilers to be one ton for each 10 indicated h. p., the vessel requiring, as shown by Table D, 1,170 indicated h. p. to attain the speed of 10 knots per hour, with a consumption of coals at the rate of 2·61 cwts. per knot, then on these data, the engines, to attain the speed of 10 knots per hour, would weigh 117 tons, and the weight of coals for a passage of, say 12,000 nautical miles, would be 12,000 × 2·61 = 31,320 cwts., or 1,566 tons weight, making together for hull, engines, and coals 2,000 + 117 + 1,566 = 3683, and consequently the displacement available for cargo would be 5,000—3,683 = 1,317 tons weight. But if it be purposed that the steaming speed shall be at the rate of 15 knots per hour, the required power, as appears by Table D, will be 3,947 ind. h. p., consequently the weight of the engines will be 395 tons and the maximum displacement available for coals will be 5,009—2,395 = 2,605 tons weight, or 52,100 cwt., which, at the tabulated rate of consumption, 5·87 cwts. per knot, would be sufficient only for a passage of 8,876 nautical miles, and this to the utter exclusion of all goods cargo, showing that the ship is inadequate for steaming 12,000 nautical miles at the required speed of 15 knots per hour, though the same ship, if duly fitted with engine-power for steaming at 10 knots per hour, would perform the whole passage of 12,000 nautical miles without re-coaling at any intermediate station, and carry 1,317 tons of remunerating goods cargo.

These few examples will, it is hoped, sufficiently illustrate the application and use of Tables C and D in facilitating mercantile inquiry into the capabilities of steam-ships with reference to the all-important question of consumption of coals; but in order still further to facilitate calculations on this subject, the Diagram E has been prepared, whence, simply by inspection, the consumption of coals per knot, at any rate of speed, may be approximately ascertained for vessels from 1,000 tons displacement up to 25,000 tons, the data on which this diagram has been calculated being the same as that on which Tables C and D are based.

The use and application of this Diagram E is evident; it brings the tables under occular review, and generalises their application. It is given as an example of a system that admits of being more fully and elaborately developed for the purposes of mercantile tabular reference, as is now being done for publication.

Having thus explained the use and application of Tables C and D and the Diagram E, it will be perceived that the task which I have undertaken on this occasion is to show palpably by comparison with those tabular statements, *based on data within the limits of already realised results*, taken as a standard, what is the character of steam-ships as respects their locomotive or dynamic capabilities, with reference to the economic performance of mercantile transport service, so far as dependant on the consumption of fuel, thus affording an exposition whereby parties interested in steam shipping, either as owners or directors, or agents, or as the charterers of shipping for government or for private service, though unacquainted with the details of marine engineering as a science, may be enabled to arrive at some definite appreciation of the amount of work that may be expected of steamers; that is, the weight of cargo they will carry, and the length of passage capable of being performed at any definite speed, for, as before observed, the dead weight of cargo that a ship will carry is equal to the tons' weight of water displaced between the light and load water-lines of the ship, less the weight of coals required for the voyage, and which for long voyages commonly amounts to four times the weight of cargo chargeable as freight, and it constitutes the limitation of distance which the ship is able to run under steam at a given speed. This inquiry is therefore essential to a due appreciaeion of the economic consequences which are involved in progressive variations of steam-ship speed, especially as respects the high rates of speed, which are occasionally professed, but which are seldom realised, simply because there has been no recognised exposition, whereby such pretensions may be judged of with reference to the required consumption of fuel. In short, regarding this matter as a public cause, affecting as it does the pecuniary interest of the public to the extent of millions sterling per annum, my object is to promulgate, through the medium of the notoriety which every inquiry obtains upon its being brought before the "British Association for the Advancement of Science," a Mercantile Steam Ship Expositor, by reference to which as a standard of comparison the good or bad qualities of steam shipping may be determined; and this surely is a public cause, for by the operation of the scrutiny which such a system of comparative exposition may be expected to inaugurate and popularise, steamers will soon become *marketable, with reference, in great measure, to their capabilities for economic transport service*, according to the speed that may be required; and under the influence of this scrutiny all bad types of form and vicious adaptation of mechanical system, will be eradicated; incompetency in steam-ship management will become gradually eliminated, and the mercantile transport service of the country being then performed exclusively by good, well-appointed, and well-managed ships, would be performed at a *minimum* of cost to the shipping interests, and consequently to the *best advantage* for the interests of the public. Hitherto the dynamic character of steam-ships has been a mechanical problem enveloped in undefined and even delusive terms of shipping and engineering art; consequently its determination has not been based on any recognized principles of calculation. Hence the dynamical character of shipping has been a mystery —a matter of mere assertion on the one hand, and of credulity on the other. But mystery being unveiled, commercial vision will be opened, and competition, in shipping as in any other well understood and open field of public enterprise, will insure the mercantile transport service of the country being performed to the best advantage, and it will gradually establish and preserve the just equilibrium of trade as between the carriers and consumers of all the sea-borne productions of the earth.

CHAS. ATHERTON.

Woolwich Dockyard, 1*st September*, 1859.

ENGINES OF THE CALLAO, LIMA, AND BOGOTA.

By John Elder, Engineer, Glasgow.

At last year's meeting of this Association, the writer gave a description, with plans, of the various double cylinder expansion marine engines for ocean steam-ships, that had been constructed by his firm during the last six years; he has now the pleasure of adding those of the Callao, Lima and Bogota, together with those of some others now in progress.

Before entering on this subject he has to remind the Association that these engines are constructed with the view of getting the greatest amount of power from a given quantity of steam, at a given pressure, with less total weight of engine-boilers and water, and occupying less total space than that occupied by the ordinary class of steam-engines on board of steam-ships.

At that meeting he had mentioned that these steam-ships, with the ordinary first-class system of machinery, were coming from Valparaiso to this country to have their engines replaced by these double-cylinder engines, entirely for the purpose of saving of fuel. The two ships there referred to are the Lima and Bogota. They are of the following dimensions:—Length, 245 feet; breadth over spinning, 36 feet; depth, 23 feet; breadth between paddle-boxes, 86 feet; tonnage, 1,650 tons. These ships had formerly a full poop and forecastle, which was altered this year into a spar deck, and the hulls of the ship increased in weight about 120 tons; the cabin and hold accommodation was lengthened 30 feet by the space saved by the smaller quantity of coal and boiler space required for the new machinery; and the registered tonnage of the ship was increased by upwards of 400 tons.

In the engines of the Lima, Callao, and Bogota, the cylinder capacity is so great as to admit of the steam being expanded to within two pounds of the pressure in the condenser at the end of the stroke, while the engines are working full power; and as the nominal power of these engines is contracted to be 320, the cylinders are 90 in diameter, and five feet stroke, and, in order to reduce the violent shock of high-pressure steam on such a large piston, and also to increase the jacket surfaces, a cylinder of one-third the size, or 25in. diameter, and 5 feet stroke, is placed close to it. This small cylinder receives the steam direct from the boiler during one-third of its stroke; this steam is consequently reduced to one-third of its original pressure at the end of its stroke, and then enters the second cylinder, where it is expanded three times more, making a total of nine volumes. Thus 42 lbs. steam is expanded nine times, or to $4\frac{2}{3}$ lbs., namely, from 42 lbs. to 14 lbs. in the small cylinder; it then enters the large cylinder at 14lbs., and is expanded to $4\frac{2}{3}$ lbs., but as the second piston is three times the size of the first, the gross load will be the same on both pistons, and the piston rods, crossheads, and connecting rods may be duplicates of each other.

From the above pressures of steam at the entering of the cylinder, it is evident, that unless the inside surface of the large cylinder is retained about 210 degrees, condensation of the steam on entering is certain, and such condensation will chiefly evaporate into the condenser while the eduction port is open, and the latent heat necessary to evaporate such condensation will be much greater than what would have radiated from the hot cylinder to the condenser, had no condensation taken place; and such heat would be entirely lost. In the same manner it might be mentioned, hat the inside surface of the small cylinder should be retained as high in temperature as the steam that enters it; and in order to attain this object every effort should be made in the construction of steam machinery. It is evident that, for the small cylinder, superheated steam is absolutely necessary for this purpose, either in the jacket or cisterns of the cylinder; and in the large cylinder the temperature of steam direct from the boiler to the cylinder may be sufficient, if communicated through a large enough pipe or aperture.

In the engines under description the pipe supplying steam to the jackets was $2\frac{1}{2}$ in. diameter, and the steam was superheated to upwards of 400 degrees that entered the jacket. It was found that a large supply to the jacket saved a vast quantity of heat, which can only be explained by the principles above mentioned, namely, that any quantity of heat supplied to the jackets assisted in proportion to the quantity of latent heat it saved being evaporated to the condenser during the eduction of the steam, and if the pipes to the jackets were large enough, or sufficient to prevent the condensation referred to, the economy of the machinery was realised to the greatest extent.

The writer begs to call the attention of all parties concerned to the performance of Cornish pumping engines, and more particularly to the similarity of action of the steam jacket in these engines to the principle of that of the double cylinder engine with steam jackets. In the Cornish engine the piston is single acting, and the jacket has twice the time to do its work, or rather the steam in the cylinder is twice the time in contact with the jackets that it is generally with Watts' engine, also that the Cornish engines have very large jacket surfaces in proportion to the power developed. With these features in view, the engineers constructed the engines now under discussion, and to this cause may be attributed a considerable portion of their success, and to the non-observance of these features the almost total failure of economy in the expansive working of most steam-engines on board of steam-ships, namely, by constructing large engines, going slow, without steam jackets, or superheating of steam, such engines would, of course, present a most favourable opportunity for improvement by adding any mode of superheating apparatus.

The writer, however, begs to call attention to the fact that in the Cunard line, and many of our ocean steamers where very high steam-chests and large hot uptakes pass up through the steam, the economy of expansion has never been questioned, but can be substantiated to a considerable extent at any time. It is likely, however that were the temperature of the steam from such boilers ascertained, it would be found considerably superheated. And the use of the various modes of superheating has been rendered much more necessary than it otherwise would have been, by engineers generally following that type of tubular boiler used by the Admiralty where there are low steam chests, and short uptakes, said to be rendered necessary in the case of the Admiralty on account of exposure to shot.

From the foregoing it is also conclusive that with the ordinary construction of steam-engines afloat, that small engines going fast would consume less coal per indicated horse-power than large engines going slow, but with engines such as those of the Callao, Bogota, and Lima the converse will be the case, carried, of course, to within moderate limits.

Again, to return to the case of the Callao, Lima, and Bogota, the general construction of the engines and boilers are as follows:—The cylinders are four in number, namely, two of 52 inches diameter, and two of 90 inches diameter and 5 feet stroke. The cylinders lie diagonally to each other. The steam and eduction valves are wrought with eccentrics, the steam valve is a gridiron valve with large lap; one eduction valve serves as eduction for the high and its corresponding low-pressed cylinder; it has no lap, and the eduction port remains open during the entire stroke of the piston, thereby giving a free egress for the steam, and ample escape for water should it form.

In reversing the engines the eccentrics are made to overrun the engines by a donkey engine till they arrive at the backing position—a plan which is less likely to cause accident than the ordinary methods. This donkey-engine has been found to be most satisfactory in its application.

The boilers are tubular, two in number, with iron tubes.

Each boiler has three furnaces, 3 feet 4 inches wide, and 6½ feet long, or making an aggregate of 130 square feet of fire-grate.

The tubes are of iron, 288 in number, 4 inches inside diameter, and 6½ feet long. Each vessel has an oval steam chest, 12 feet high, and 8 feet long, and 5 feet broad, with three uptakes through this steam chest each 2 feet diameter and 15 feet long. This makes a strong form of takeup where it joins the tube plate, especially in boilers firing across the ship; the feed-pipe of the boilers enters into a long flat tank or shield in front of the furnaces in which the furnace-doors are formed. This shield forms a protection to the firemen from heat, and makes the heat, otherwise lost, available for the feed water. In the Callao there is a third coil of feed-pipe in the funnel, to heat the feed water. Such then, are the leading features of this machinery, and the results are as follows:—

This plan of the boilers gave steam to the engines superheated to about 400 degrees by the uptakes, showing that the various systems of superheating are unnecessarily complicated; indeed, in the Lima, the steam got so far above 400 degrees, that in the Bogota the steam chests were made 2 feet lower, and two small feed-pipes were made to feed the boiler when too much superheated by the tap of the steam chest. The superheated steam, though upwards of 400 degrees of heat, was found quite inadequate to prevent condensation in the cylinder, without the steam-jacket cock being full open.

The writer begs to press this fact on your notice, as in the case of double cylinder engines it is so prominently observed, by comparing the respective diagrams of the low and high-pressed cylinders, especially as those engines, where the cylinders are so close that the diagram of one is an exact counterpart of the other, when there is no condensation; and it is somewhat curious to observe, while taking diagrams of the low-pressed cylinder, the gradual development of the diagram, with the jacket-cock full open, compared with that when it is shut.

When the steam was at a pressure of 21 pounds above the atmosphere the temperature at the surface of the water was 264 degs., and at the top of the steam chest 400 degs. Faht., showing that the steam was surcharged to the extent of 136 degs., notwithstanding that the steam was in direct and unimpebed contact with the surface of the water. The engines made during the trial trips, which were generally half a day in length, from about 23 to 26 revolutions, and indicated from 1,000 to 1,300 horse-power during that time, and consumed from 20 to 25 cwts. per hour, with the surface-blow-off cocks open. The Callao, Lima, and Bogota have all shown a consumption of from 2 to 2½ pounds per indicated horse-power per hour best Welsh coals, and the speed of the ships from 12½ to 13 knots per hour.

The steam-ship Callao has now been plying betweeh Valparaiso and Panama with Her Majesty's mails, for upwards of nine months, and has performed her work in a most satisfactory manner. The distance between these ports is upwards of 3,200 miles, and this she performs regularly on about 300 tons of coals. The Callao made the run from Liverpool to Valparaiso in, I think, about 36 days steaming time, which averages about 240 miles per day during a run of 9,000 miles on a consumption of about 20 cwts. per hour. The Lima has also arrived at her destination, after a most successful run; she performed the distance of 1,500 miles, from Valparaiso to Callao in 141 hours consuming 150 tons of coals, logging at an average of 260 miles per day during that distance, considerably faster than she had ever done with her original engines, and on less than half the coals consumed. The Bagota was completed and tested on the first of September last, and found fully equal to the others. She made the run from the Cloch Light in the Clyde to the Hell Buoy at Liverpool in 15 hours, against a strong head wind, and eonsumed during that distance 15 tons of Scotch coals.

At the Admiralty trial, which took place immediately on her arrival at Liverpool, she averaged upwards of 13 knots, the engine made 25½ revolutions; she indicated 1·080 horse-power, and consumed about 21 cwts. per hour of Scotch coals; the steam was superheated to 340 degrees on entering the cylinder, and the thermometer at the water level of the boiler showed 264; the pressure in the boilers was 27 lbs., and the vacuum in the condensers 26 inches. She left Liverpool for Valparaiso on the 11th of the present month, with sufficient coals to carry her 5,000 miles, at 240 miles per day, and a full complement of stores for the passengers on board; her draught of water on leaving Liverpool at the load line was, aft, 14 ft. 6 in.; forward, 13 ft. 9 in.; and displacement, 1,700 tons. She steamed to the Holyhead Light, where the pilot left her, at the rate of 11¾ nautical miles per hour against a strong head wind; the engines were making 20 revolutions; the steam-pressure was 26 lbs.; the vacuum 26 inches; and the consumption of coals 22 cwts. best Welsh coals per hour.

The engineers are now constructing the machinery for three other steam-ships on this principle, with boilers on the cellular cylindrical spiral principle. In conclusion, the form of engines now described gives regularity of motion, while working expansively to the fullest extent, the expansion principle is fully realised, and the engines are of a strong architectural figure, with the various parts easily got at, and reduced to simple forms, and present every facility for reversing freely by the engine-driver.

It may be interesting to the meeting to state that the performance of the Lima on a trial trip of considerable distance, namely, between Liverpol and Dublin, was made several months ago, under the observation of a member of the Steamship Performance Committee, appointed by the British Association at its last meeting in Leeds, and that the member of your Committee who attended upon that occasion watched the performance of the ship and her machinery wlth the utmost minuteness, in conjunction with the Admiralty Engineer; and an accurate return has been made to your Committee, in accordance with the form prescribed and recommended for general adoption; anb it will be found on reference to the Report of the Committee on Steam Ship Performance, presented to the Association a few days ago, that all the dimensions and particulars of performance of the Lima are embodied therein.

In conclusion, I beg to observe that the recorded performance of the Lima was not a mere *measured mile trial*, which may be always be made to appear more favourable than practical experience afterwards attains, but was such an extended trial as your Committee had previously recommended, and which recommendation was adopted by the Directors of tbe Pacific Steam Ship Company, the owners of the Lima, and with what amount of successful result I have the satisfaction of now referring you to the "Return," and I sincerely trust that the labours of the Committee on Steam Ship Performance will continue, anb that the systematic recording of facts which it advocates will be persisted in; for I know nothing so likely to prove useful in stimulating the marine engine builder to rapid and certain practical improvement, and to make the owners of steam ships aware of their true position, and of the real value of their property.

Note.—A return of the performance of the *Lima* will be found at page of the present number. The lines of these ships are given in a plate (No. 151) accompanying the present number. A series of plates, illustrating the machinery of these vessels, will be given in the following numbers of the *Artizan*.

CONDENSED ABSTRACT OF A FIRST SET OF EXPERIMENTS, BY MESSRS. ROBERT NAPIER AND SONS, ON THE STRENGTH OF WROUGHT IRON AND STEEL.

Communicated by W. J. Macquorn Rankine, C.E., LL.D., F.R.S.S., L. & E.

The experiments to which this abstract relates form the first set of a long series now in progress by Messrs. Robert Napier and Sons, the details being conducted by their assistant, Mr. Kirkealdy. The whole results are now in the course of being printed *in extenso*, for publication in the "Transactions of the Institution of Engineers in Scotland;" but some time must elapse before they can appear, owing to the great volume of the tables, and the number of particulars which they give.

The present abstract is all that it has been found practicable to prepare in time for the meeting of the British Association, and, notwithstanding its brevity aud extreme condensation, it is believed that the results which it shows will be found of interest and importance. It gives the tenacity, and the ultimate extension when, on the point of being torn asunder, of the *strongest* and the *weakest* kinds of iron and steel from each of the districts mentioned. Each result is the mean of four experiments at least, and sometimes of many more.

The detailed tables, now being printed, will show many more particulars, and especially the contraction of the bars in transverse area along their length generally, owing to "drawing out," aud the still greater contraction at the point of fracture. The experiments now complete were all made with loads applied gradually. Experiments ou the effect of suddenly applied loads are in progress.

Table A.—Iron Bars.

	Tenacity in lbs. per sq. inch.	Ultimate extension in decimals of length.
Yorkshire: strongest	62886	0·256
" weakest	60075	0·205
" (forged)	66392	0·202
Staffordshire: strongest	62231	0·222
" weakest	56715	0·225
West of Scotland: strongest	64795	0·173
" weakest	56655	0·191
Sweden: strongest	48232	0·264
" weakest	47855	0·278
Russia: strongest	56805	0·153
" weakest	49564	0·133

Table B.—Iron Plates.

	Tenacity in lbs. per sq. inch.	Ultimate extension in decimals of length.
Yorkshire; strongest lengthwise	56005	0·141
" weakest lengthwise	52000	0·131
" strongest crosswise	50515	0·093
" weakest crosswise	46221	0·076

Note.—The strongest lengthwise is the weakest crosswise, and *vice versâ*.

Table C.—Steel Bars.

	Tenacity in lbs. per sq. inch.	Ultimate extension in decimals of length.
Steel for tools, rivets, &c.: strongest	132909	0·054
" weakest	101151	0·108
Steel for other purposes: strongest	92015	0·153
" weakest	71486	

Table D.—Steel Plates.

	Tenacity in lbs. per sq. inch.	Ultimate extension in decimals of length.
Strongest lengthwise	94289	0·0571
Weakest lengthwise	95594	0·1986
Strongest crosswise	96308	0·0964
Weakest crosswise	69016	0·1964

Note.—The strongest and weakest leugthwise are also respectively the strongest and weakest crosswise.

THE ASSOCIATION OF FOREMEN ENGINEERS.

On Saturday, 17th September, the anniversary dinner of the "Association of Foremen of the Engineeriug Trade" took place at their rooms, 35, St. Swithen's-lane, City. Mr. Newton, of the Royal Mint, in the chair, was supported by from eighty to ninety members and frieuds of the society. After dinner the usual loyal and complimentary toasts were druuk, being severally prefaced by brief but appropriate and able speeches from the president. In giving the "Prince Consort and the rest of the Royal family," the chairman took the opportuuity of saying that his royal highness never distinguished himself more than when at Aberdeen the other day he paid homage to the votaries of science, and ackuowledged himself a devotee at her sacred shrine. "Our Employers" was the next toast of the programme. The chairman in proposing this said, he considered it to be a toast in which every individual member of the association must feel a direct and personal interest. It was not necessary to urge the complete and indossolulible identity of interest which existed betweeu masters and foremen engineers. Not one among their own body would think of disputing such a positiou. "We one and all" said he, "are aware that employers cannot fail without foremen feeling the effects of their failure, and that in ther prosperity is bound up our own fortunes." He must be permitted to say, however, that from the attitude assumed by engiueeriug employers generally towards the Foremens' Association, he was afraid that they did not regard this intellectual, moral, and charitable union with the favour which it had a right to expect at their hands. It was certain that the masters' advantage was bound up in the welfare of those who served them, and it was unfortunate that so much coldness should be manifested towards a society such as that over which he had the honour to preside, by employers generally. Would that employers would attend their monthly meetings, and learn from their own observation that their's was no unfair banding together for the purpose of coercing the labour market, but simply a union for mutual improvement and for provident objects. Would that an employer occupied to-night the chair he so uuworthily filled!" Mr. Newton then proceeded to say, that he trusted from henceforth the Association of Foremeu Engineers would emerge from the dark cloud which seemed to obstruct the vision of employers, and that the latter would join the society iu large numbers as honorary members.

Mr. Fowler, au employer, in respondiug to this toast, disclaimed to some extent the strictures of the chairman as to the isolation of employers generally from the interests of the society, and concluded by hauding ln his own name and subscription as an honorary member.

"Honorary Members and Supporters" was the next toast, and this was responded to by Mr. Blackett.

"Prosperity to the Association of Foremen Engineers" and the chairman having expressed his views of the importance of the institution, and his confidence in its permanent well-being and increasing usefulness, called upon the secretary to furnish from his minute book the substantial reasons he had for forming those conclusions. Mr. Joues then proceeded to read an abstract report of the society's rise, progress, and present prospects, the substance of which we snbjoin:—

"Sir, I have the satisfaction of presenting, in compliance with your request, a brief history of the Association of Foremen Engineers, with some account of its present financial condition. In the year 1852 several members now present, together with Mr. Sheaves, now, alas uo more; Mr. Allison, whose unfortunate accident we all deplore, and myself, first met to discuss the desirability of forming an association of foremen of the branches of the eugineering trade. The matter was fully considered on these occasions, a committee was formed, meeting uights, once or twice in each week, were appointed in order to frame rules and to make regulations, and ultimately from those small beginnings grew into existence the now flourishing society of which we are all so proud. It mnst, however, in justice to the memory of our late lamented chairman, be admitted that the idea of such a society originated with himself.

COLT'S REVOLVING RIFLE.

Of course, for actual service, one of the great desiderata of a rifle is rapidity of action,—and this is attained to a marvellous degree by the revolving rifle invented by Colonel Colt, and now greatly in use in the United States, India, and the Colonies. The arm is, in general principle, the same as the colonel's pistols, which we have heretofore described, but its adaptation to the rifle so as to be used in the ranks, is a most important matter, and one likely to be extremely valuable in time of actual warfare, as by it the rifle-man is euablad to fire six successive shots, with deadly aim aud unerring precision, without lowering the piece from his shoulder; aud he may be provided with another—and another—ready loaded cylinder, in his pouch, which he can, in as little time as in ordinary cases it takes to load even one of the best constructed breech-loaders, put in place of the exploded one, and thus keep up a running fire of twelve, eighteen, twenty-four, or any other number of shots accordiug to the number of cylinders with which he is furnished. And all this may be done by the skirmisher, without the possibility of being seen, as the loading, or replacing of the cylinder, is effected, of course, at the breech, and can be done with ease in any position, either kneeling, sitting, crouching, or lying down.

Colt's Revolving Rifle, which can be loaded either by flask or cartridge, has been used with astonishing effect bv celebrated American hunters in their expeditions into the vast forests of the interior, and by mauy of our officers at the Cape and in India, and on many occasions the power of firing six shots before reloading has rescued them from situatious of great danger. They pronounce it an irresistible and efficient weapon, which may be always relied upon, and affords an unfailing resource.

MR. F. SILAS'S NEW LIGHT.

On the evening of September 26th, a series of very interesting experiments took place in the Serpentine, in the presence of some members of the Committee of the Royal Humane Society, and their secretary, with the new light, the invention of the above geutleman.

One of the peculiarities of this light is, that it cannot be extinguished by water; in fact, the presence of water is needful to secure its being lighted. The inventor proposes to use it for the night life-buoys, as at present used in Her Majesty's ships and other large vessels, in place of the ordinary port-fire, which is always liable to be extinguished in a heavy sea, rendering this buoy under such circumstances useless.

The lights burned with very great brilliancy in spite of torrents of rain, which fell without intermission during the whole of the experiments, which lasted about two hours, and was quite as vivid as the electric light, and quite steady; and though they were repeatedly immersed some feet under water, they instantly burst into flame on their emergence.

The inventor, accompanied by the secretary, Mr. Young, were in a boat in the middle of the Serpentiue, and the light was so strong that small print could easily be read by a person on the shore. The effect of the light on the bridge, and the shade of the arches, was very beautiful.

A railway, or other signal light was also exhibited, which gave an intense and extremely powerful light, easily visible at eight or ten miles; aud this new light will, no doubt, if it can be economically manufactured, supersede the employment of the ordinary post-fire, and for boat and ship use, or where the ordinary lights would be affected by damp, it will be invaluable.

The experiments gave the greatest satisfaction, and convinced every one present of its efficiency and utility.

NEWCASTLE.

We learn from Newcastle that the Galway Boats are making progress; one being well in frame, and the other nearly as far advanced. They have three 80-inch cylinders with 7 ft. stroke, oscillating; two air-pumps worked by a separate single oscillating cylinder 44 in. diameter. There are eight boilers each with five furnaces. Paddle-wheels, feathering of, 36 ft. diameter. Messrs. Hawthorn's are constructing the wheels and separate air-pump engines.

Both Hawthorn's and Palmer's are working night and day in several departments. Messrs. Stephenson's are also very busy; and there appears sufficient work for the next two or three years.

CORRESPONDENCE.

We do not hold ourselves responsible for the opinions of our Correspondents.—Ed.

VERTICAL FIRE WITH ARROWS OR BOLTS.

To the Editor of the Artizan.

Sir,—The employment of arrows for vertical fires, as put in practice by the Chiuese in the defences of their forts during the late disastrous attack by our sea and land forces at the mouth of the Peibo River, will excite some discussion as to tbe merits of such vertical fire, and as this flight of an arrow-shot from a Chinese bow, does not exceed two hundred yards; I beg to state that I was in the habit of shooting a bolt from a horse pistol of the "Brown Bess" bore, by vertical fire, at Cork, about seven years ago, to the distance of more than four hundred yards. The weight of the bolt was with its iron head, between three and four hundred ounces; the cartridge was attached to the inner end of the bolt, and did not require to be opened previous to insertion. The head of this bolt projected an inch or two from the muzzle of the pistol, and its shaft being the full length of the barrel, caused it to form its own ramroad. I made the above experiments to prove that the guard of a railway train could, from the rear of the trains, throw a whistling or explosive bolt high over the head of the driver of the engines, and hus gives him warning when requir ed.

I am, Yours, &c.,
J. Norton.

STEAM JACKETS AND CUT-OFFS.

To the Editor of The Artizan.

Sir,—You have already conferred on me a distinguished houour by publishing some views respecting the progress of inventions and labour-saving machines, which, in principle, appear opposed to the spirit of the age we live in; for if "Society has outlived the theory of balances," it is, so to speak, living out of nature in a state both artificial and destructive. Nevertheless, it is to be hoped that good seed, sown even on barren soils, will, in due time, spring up and produce fruit.

It appears to me that your remarks on the steam jacket, and on expansive gear, require some farther elucidation. Will some of your readers be kind enough to furnish us with their opinions on the following questions.

1. Are we to understand that pistons, without being oiled, will work easy and preserve their fitness when high-pressure steam is used expansively on a good vacuum, if the steam jacket is supplied with super-heated steam?

2. And if tbe steam inside the steam jacket is not hotter than the initial steam in the cylinder, will it, in the broad sense, be more economical than a simple uonconducting covering?

3. Would not the extra loss of heat from a moist cylinder be more than compensated by cutting it off from the condeuser about a third of the time, provided tbe covers only were heated, and working on a good vacuum?

4. Will there not be less condensation on the piston when the cylindrical portion of the cylinder is *not* steam jacketed?

5. Has not the loss of steam produced from moist pistons, when working expansively on a good vacuum, been altogether omitted by engineers?

6. Is there not greater economy by allowing steam to expand, and dry, and cool before it euters the cylinder, causing the heated covers to be comparatively hotter, and the engine always above its work?

7. And is it not better, especially for high-pressure steam, to have multiple cylinders of different areas placed at right angles (with a moderate expansion in each effected by the lap on the valve), thus balancing the power and saving the expansive gear which causes so many losses and irregularities?

I ask these questions because similar views have beeu published in The Artizan, and elsewhere, which have neither been refuted or noticed.

September 7th, 1859. Henry Pratt.

HEAT ENGINES.

To the Editor of The Artizan.

Sir,—In a letter to the *North British Daily Mail*, Mr. James R. Napier, of Glasgow, in reporting on the screw steamship *Thetis*, says:—"The theory of the steam-engine established by Watt has been laid aside, and one of heat engines, in general more in accordance with facts, is being gradually adopted." If this expression is intended to convey that Regnault's law is adopted and Watt's laid aside, well and good; but does this destroy the theory of Watt's steam-engine? Is not the concentration of motion within a boiler, producing heat, and tbe local destructiou or transfer of that notion in a separate condenser, producing cold, tbe basis or theory upon which Watt's steam-engine is founded? And do the engines on board the screw steamship *Thetis* work upon rny oter principle or tbeory?

You may concentrate motion to a greater extent than Watt did, and thus generate greater heat and pressure. You may use surface condensers, and metamorphose the air-pump. You may even apply the atmosphere, as the cooling medium, to condense with, when water is not present. You may prevent undue condensation in the cylinder, and stop heat from going into the condeuser by cutting off the cylinder from it. You may apply a multiple cylinder engine of different areas to expand, superheat, and balance the power. You may also concentrate motion in combustion chambers to a greater extent than Watt did, and apply the heat more economically to plain boilers for low-pressure steam, or to strictly tubular boilers for high-pressure steam. You may use improved furnace valve-doors and fire-places to economise fuel. You may do all these things, and adopt other improvements, by which three out of four, or 75 per cent. of fuel, may be saved; nevertheless, it is a steam-engine still.

When I see important improvements revealed to the world in the daily papers not appropriated to the investigation of such matters, there is one thing, sir, which strikes me. Aud what is it? That the main improvements in the screw steamship *Thetis* originated with Mr. Craddock, however they may have been modified, and that his name has been suppressed. Mr. Craddock bas, in common with other inventors and artizans, strong claims on his country. Mr. Cobden had £70,000 subscribed for him by his supporters. Our heroes have been honoued and rewarded iu their lifetime, and it is high time that something should be done for meritorous inventors and manufacturers whose lives have been devoted to tbe improvements of the arts of life, and who have received no recompense whatever for their labours and discoveries.

September 9th, 1859. Henry Pratt.

DEATH OF I. K. BRUNEL, ESQ.

The eminent Engineer, Mr. Isambard Kingdom Brunel, (son of Sir Mark Isambard Brunel, the Constructor of the Thames Tunnel) originator of the *Great Eastern* Steamer, died on the 15th September ult., at his residence, Duke Street, Westminster, whither he had been conveyed, on the 5th of the same month (having been on that day seized with paralysis), from on board the *Great Eastern* ship. Mr. Brunel was appointed Engineer to the Great Western Railway, in 1833. His chief works were the bridges across the Thames, at Maidenhead, at Chepstow, over the Wye; the Cornwall Railway Bridge, now erecting over the Tamar (whose central pier, rising from 80 feet of water, is the deepest yet encountered in Railway-Engineering); the Hungerford Suspension Foot-Bridge across the Thames (having the longest span in England); the floating and raising of the Conway and Britannia Tubular Bridges; his Guage, and other great works as Railway-Engineer, and, lastly, his creation of the *Great Eastern* Steamship—the news of the recent mishap on board of which, is understood to have hastened his decease.

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c.

Under this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the varions departments treated of in our Jonrnal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.—Ed.

The Fatal Explosion on board the "Great Eastern."—At Weymouth, 12th September ult., a coroner's inquest was held on the five unfortunate stokers, killed by the explosion. The engineering evidence went to prove that, commnnication between the bottom of the funnel casing and the boilers having by some means unexplained been cut off—(it would appear by the affixing a brass cock to the end of the stand-pipe, when testing the cases by hydraulic pressure, and which cock had by some fatal inadvertence been neglected to be removed)—the immense water-casing became a monstrous vertical boiler, withont a safety valve, or any vent whatever; that the "stand-pipe," if not meddled with, being open at top, would have constituted an efficient safety-valve. That if the feed (of the boilers) had been contimned through the "jacket," or if the "stand-pipe" had been in operation, the explosion would not have occurred. Neither could it have occurred if the cock had been taken off. The inquest was adjourned to 14th September. The adjourned inquest, held at Weymouth, (the jury having in the interim inspected the vessel, and examined the water casing, the bursting of which was the cause of death), was by the coroner further adjourned to the 17th, to secnre the attendance of the Surveyor-General of the Board of Trade (Captain Robertson) as likewise of the man who lengthened the stand-pipe, the imputation at the opening of the inquest being, that the man who lengthened the stand-pipe screwed in the tap of the water-casing, and so left it." Mr. Scott Russell stated, that it would be shown in evidence that previously to the sailing of the vessel the cock was found open. The Company's solicitor said that he should endeavour to show that the Company were in no way responsible for this deplorable accident. The coroner here remarked, "And I presume that Mr. Scott Russell will endeavour to show that the responsibility does not rest upon him." To which Mr. S. Russell replied, "All we wish to know is, who was the man who shut the cock which caused the explosion." 17th September, inquest adjourned. On this occasion Mr. Scott Russell, in his evidence, insisted that during the trial-trip the paddle-engines were never under his charge; that from the day when the fourth trial of the engines was made in the river, in the presence of Mr. Brunel, he considered that they were entirely delivered up to the Company. Mr. Scott Russell's foreman said it was by his (witness's) directions that the cock in the tube was fixed. He considered such cock was necessary, as if the pipe had been broken, and there had been no means of shutting off the water, it would have spoilt the saloon beneath. One of the engineers of the *Great Eastern* said it was he (witness) who shut the feed off from the funnel-casing to the boilers in both sets of boilers, in order to keep down the priming of the boilers. In so doing, "he never dreamt of finding a cock in an escape-pipe like the syphon." Inquest further adjourned to 19th September ult., when the jury delivered the following statement:—"We find that the deceased came to their deaths from injuries received from steam, hot air, and water, in consequence of the bursting of the jacket attached to the foremost funnel of the *Great Eastern* steamer, and that the said bursting was caused by the closing of a tap connected with the syphon attached to the said jacket, in conjunction with the shutting off the feed from the water casing to the boilers; but there is no evidence before the jury to show by what person or persons the said tap was shut off; and the jury further express their opinion that taps are highly dangerous when placed in such positions, and that sufficient caution was not used by the engineers." Their verdict, however, was one simply of "Accidental Death!"

Wilful Damage to Drinking Fountains.—At Bow-street Police-court, 1st September ult. Mr. Langdale, the donor of a recently-erected public drinking fountain, in Eudell-street, St. Giles's, complained to the sitting magistrate of wilful and malicious damage having been done to the fountain; the water had ceased to flow, and the cups, chain, grating, &c., had been stolen, although much force must have been used to wrench them off. He had caused fresh cups, and still stronger chains to be attached, and the water was again flowing. His object in addressing the magistrate was, to beg that the police on duty there might be directed to keep an eye on the fountain. Mr. Henry said he would mention the snbject to the police, although, of course, it would be impossible to place a constable on duty at every fountain in London.

Coals in Railway-Engines.—Fine.—The Liverpool magistrates (30th August ult., imposed a fine, under the Railway Cousolidation Act, upon the Loudon and North-Western Railway Company, for burning coals in their engines, and thereby causing a nuisance to the inhabitants of Spekeland Cottages, near Edgehill Station.

NOTICES TO CORRESPONDENTS.

J. C. D.—Declined.

R. Whiston.—We have forwarded the papers to Russia as requested.

Inquirer.—J. B.; J. Robertson: P. P.; Butterley; N. Junr. Will reply by post.

N. D. Y.—In reply to your inquiry as to the manner of using the concrete in the foundations of the piers of Westminster Bridge, the following will explain:—When the external sheet piling of the piers is so far completed that any rush of the tide through the pier is prevented, and the water quiescent, the concrete, mixed on a stage some height above the water, is shot through a long shoot into its place, where, by its momentum and weight, it consolidates into a solid mass, in the words of Messrs. R. Stephenson, Fowler, and Hawkshaw, "harder than the stone of the old bridge."

Ruby (Birmingham).—248° Fahr. corresponds with 120° Centrigrade, and with 96° Reaum. The freezing-point of water (in the Fahrenheit scale 32°) is the zero of each of the other scales, and 100° Cent. and 80° Reaum. correspond with 112° Fahr.

Other correspondents have been replied to by post.

W. H. D.—No such establishment as a "Club for Surveyors" exists. The Royal Institute of British Architects, the Institution of Civil Engineers, and the Society of Arts are the best rallying-points during the London season. You will see all the leading members of those professions there. Write to the Editor of the *Building News*.

New Subscriber.—You will find the boilers, engines, and hull of the *Great Eastern* described and illustrated in the four preceding volumes.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

We have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefitting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this, would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "18, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

Heinke's Diving Apparatus has been recently officially tested by the Sappers and Miners of the Royal East India Engineers, who have been employed in diving near Rochester Bridge. Several tons of the large masses of stone which were scattered into the river on the blowing up of the old bridge by the Royal Engineers, were, with the aid of the new apparatus, brought up to the surface. On the 22nd August ult., several of the engineer-officers descended in the dress, and remained some time under the water, assisting in the operations which are being carried on in the bed of the river. The authorities have engaged Mr. Heinke, the inventor, to superintend the diving operations.

An Explosion from the Spontaneous Generation of Gas occurred recently on board the collier brig *Lebanon*, whilst lying at the coal drops of the Monkwearmouth Colliery, in the River Wear, having on board a cargo of gas coals. The hatches had been battened down on the previous evening, and a quantity of gas had been generated from the coal during the night, and had passed through the crevices of the bulkhead into the cabin. The lighting of a lucifer match by one of the seamen, who, in the morning, went down into the cabin to light the captain's fire, caused a fearful explosion, which shook the houses and shipping for upwards of half a mile round. The quarter-deck was blown up above the topmast of the vessel, the upper part of the stern was blown to a considerable distance, the whole of the cabin furniture destroyed, and six of the deck beams were broken. The mate, a seaman, and the cabin boy, were much injured, and much damage was done to the vessel and cargo.

A great Industrial Exhibition, in 1862, of the art-productions of all nations, in London, is again on the *tapis*. Active measures towards this object are being made by the Council of the Society of Arts; and there appears to be some probability of the English Government, in conjunction with that of France, being induced to take upon itself, this time, the initiative in a matter of such international, or rather universal interest and importance.

The Norfolk Estuary Company have entered into two contracts, by the advice of their engineers, with Mr. Sesson for the execution of works for the reclamation of the land; and these are proceeding so rapidly that their completion is announced for November next.

The Madras Irrigation Company (30th August, ult.) paid £13,340 into the Indian Treasury, in advance of calls, making, with previous payments, a total of £368,736 received by the Secretary of State for India in Council, from the Company, on account of its capital, since the 27th February last.

Spinner's Wages.—Self-Actor "Minders."—At an adjourned meeting of master spinners and manufacturers, held at Preston, recently, it was unanimously agreed to advance the wages of self-actor minders 7½ per cent. on the prices now paid; such advance to take effect after the 10th September, 1859.

The Kaleidoscope adapted to Figured Silk or Cotton Tissue.—The French Government has just issued letters of naturalisation to M. Sturm, an optician of Prague, as a reward for his invention, recently presented to the "Société d'Encouragement," and which promises to become of great service to manufacturers in every branch of silk or cotton tissues. The figures of the kaleidoscope, a contrivance hitherto considered as a mere philosophical toy, have been fixed by M. Sturm's invention, so as to render the instrument of the utmost utility and importance to designers and printed figure printers. The facility with which the same pattern is reproduced upon a various coloured ground is one curious part of the discovery. The delicacy of tint and pattern, and the method of fixing the design, will, it is anticipated, render the new instrument a valuable acquisition both to Manchester and Lyons.

The New Steering Apparatus, the invention of Mr. Langley, the shipbuilder, of Deptford, fixed on board the *Great Eastern*, will enable the officer of the watch, on the bridge, to steer the ship, by a signal-indicator, with as much certainty as if he guided the wheel himself. A small illuminated dial, with a moveable index, is fixed on the bridge, in front of the officer of the watch, and connected with another of the same description in front of the man at the helm. Moving the index-finger of the machine, on the bridge, to port or starboard moves the index of the machine before the helm at the same time, so that not a second is lost in putting the helm hard up or down. In the same manner the rudder itself is connected with another small dial before the helmsmen, which tells, by the index, that they have exactly obeyed orders; while this again communicating with a similar machine on the bridge, shows the officer of the watch the instant his commands are executed. The movement of the latter dial are of course regulated by those of the rudder, so that the officer on duty has always the helm, as it were, under his eye, and can detect if the men suffer the ship to deviate a quarter of a point from the course, even for a second. The apparatus possesses, moreover, another advantage, namely, that by simply moving over the index finger to bard-a-port, opens up two red lights on the port side; and by turning it to starboard a double green one is similarly displayed. Thus small vessels are afforded every facility for getting out of the monster vessel's way.

The Total Spread of Canvass of the *Great Eastern*, with all sails set, will be about 4800 yards, and with a strong breeze on the quarter, this, it is calculated, would suffice, without any other aid, to drive her through the water at the rate of 15 knots an hour, at least.

The Small Patent Derrick, belonging to the Patent Derrick Company, was, 26th August, ult, employed to hoist the whole of the yards and the principal gaffs of the *Great Eastern*. These spars, manufactured by Messrs. Ferguson, of Milwall, are the largest of their respective kinds ever constructed on the Thames, or elsewhere. The mainyards are 124 feet in length, 33 inches in diameter at their thickest part, and weigh from 15 to 17 tons. These enormous spars were launched and hoisted to their required positions in a single day, by means of the facilities for handling heavy weights, afforded by the Derrick. The hoisting of the largest yard to a height of nearly 80 feet, after slinging, took less than 2 minutes. By a peculiar arrangement of leverage, the Derrick was enabled, not only to hoist the yards over the ship's side, but also to span the *Great Eastern's* deck amidships, and haud her spars to the purchases rigged on board to receive them, a feat that neither crane nor shears on the Thames could accomplish.

The Indestructible Fire Apparatus, of M. Ferdinand Silas, of Paris, was, on the night of the 20th August ult., tested at Woolwich Dockyard. The experiments were made in accordance with admiralty instructions, for a complete trial of the utility of the apparatus as applied to naval purposes. The apparatus was thrown into the water from the *Bustler* steam-vessel. The invention affords the means of surveying harbours, rivers, or a coast after sunset, with a small boat, in order to ascertain the presence of buoys or other obstacles to the progress of a vessel. The flame proceeding from the apparatus, although affording an intense light, is not, as was at first supposed, applicable for purposes of destruction.

RAILWAYS.

Lines open in 1858.—By the report of Captain Galton, Royal Engineers, on the proceedings of the Board of Trade, relating to Railways in 1858, recently published as a Blue-book, it appears that 9,506 miles of line were open at the end of last year; and 4,543 miles (duly authorized) remained to be opened. 6,976 miles were open on the 31st December last, in England; 1,342 in Scotland, and 1,188 in Ireland.

Broad and Narrow Guage.—The narrow guage is quite in the ascendant; seeing that, of the 9,542 miles of line open, 6,352 miles are narrow guage, 749 only broad guage, 261 mixed guage, and 1,180 "Irish" guage. Of single lines there were (in 1858) 2,088 miles of narrow, 255 of broad, 52 of mixed, and 753 of "Irish" guage. Of 426 miles of new line, opened in 1858, 372 were laid with only one line of rails.

Of Persons employed on Railways, in course of construction (on 30th June, 1858), there were 38,546, being an average of 43·79 per mile.

Length of Line, opened for Traffic, in the United Kingdom, on 30th June, 1858, 9,323 miles; and number of persons employed thereon amounted to 109,329, or 11·72 per mile.

Total Amount raised for Railways (on 31st December, 1858), £325,375; 507 representing an expenditure of £34,243 per mile of railway open. On an average, 6 per cent. of that expenditure has been for Parliamentary and legal expenses; 18 for land and compensation, 66 for works, and 10 for rolling-stock.

The Average Rate of Dividend on the whole of the ordinary share-capital in railways invested was (last year) 3·6 against 3·60 in 1857, and 3·40 in 1856. It has always been 3 and a decimal since 1852; in that year it was 2·40; in 1851, 2·44; in 1850, 1·83; and in 1849, 1·88.

Passenger-Traffic.—Proportion to the whole traffic (in 1858), 43 per cent. in England; 36 in Scotland, and 57 in Ireland. Last year 139,193,699 persons were conveyed by railway, against 139,008,888 in 1857. Receipts (for ditto) £10,376,309. against £10,592,798 in 1857.

Of Merchandise.—25,593,996 tons (receipts, £7,711,350) were conveyed by railways in 1858.

Classification of Railway Passengers.—Of the 140,000,000 passengers (in round numbers) conveyed last year on railways in England, Scotland and Ireland, 18,302,384 were first-class; 41,693,289 second-class; 79,145,464 third-class, and Parliamentary; and 52,562 holders of annual or season-tickets.

The Increase of Length in Railways of the United Kingdom has been (in 1858) above 400 miles; but the receipts were actually less in 1858 than in 1857, by £217,861; and the working-expenses average 49 per cent. of the receipts, instead of 47 per cent., as was the case in 1857.

A novel Clause in Railway-Contracts.—For the construction of the Cowes and Newport Railway, to be completed by the 30th June next, there are 16 tenders, 12 of them offering to construct the line on their own account, and to guarantee the shareholders 6 per cent.! The Directors have deferred their decision for the present.

A "Vertical" Railway is the last (American) engineering novelty. The contrivance in question is to form one, and perhaps not the least interesting, feature, in a new and monster-hotel in the course of erection in Madison Square, New York. A carriage will move from the top to the bottom of the building (6 stories high), and from bottom to top. It will be forced upwards by steam-power, and the descent will be regulated by the resistance of hydraulic power, so as to guard against accidents. The car will be attached to a shaft, which, being turned by steam, will cause the car to proceed upwards by means of a screw, or on the principle of the inclined plane. The car stops at each floor, and passengers are landed, and others taken in. In the same way, in making the descent, it stops at each floor. Behind the vertical railway is a "Baggage Elevator," moved by the same power, intended to avoid the necessity of taking trunks up and down the stairs.

Chilian Lines.—The line of the Southern Railroad was, per late advices, expected to be ready for opening as far as Payne on the 18th September; and to be finished, as far as Rancagua, at the end of the present year.

On the Santiago and Valparaiso Road.—Works progressing favourably; line expected to be completed in 4 years.

Statistics of French Railways.—The force of the locomotives at work on the railways in France amounts to 450,000 steam horse-power, working one day out of three, and representing 1,900,000 ordinary horses, or 3,360,000 men, working 10 hours a day. In the whole world there is, on railways, steam-power to the extent of 4,150,000 horses. The annual distance performed by the locomotives on the whole globe is, 884,790,000 kilomètres (⅝ths of a mile each), or 22,119 times round the globe. Number of persons employed on the French railways about 55,000; and in the whole world it is 600,000, exclusive of many other persons, employed either directly or indirectly, by the lines. The number of those who derive their livelihood in France on the lines is, by M. Perdonnet, one of the Directors of the Eastern Railway of France, and on whose authority we quote the above statistical details, estimated at 500,000, against about the same number in England.

RAILWAY ACCIDENTS.

A serious Railway Collision occurred, night of 8th September ult., to the 9.15 train from King's Cross, by its coming in collision with an up-train from the Midland Counties, near Hitchin Station. Both trains going at full speed, the concussion caused some of the foremost carriages to mount actually on the top of each other. Several severe hurts to passengers, in 2nd class to Edinburgh, but no fatal result.

A fatal Collision on the Great Western Railway took place, 14th September ult., at the Slough Station, between a goods' train from London for Bristol, standing at the station, and a special train from Oxford. The latter, consisting of several empty carriages, ran with great velocity into the goods' train, turning over both engines, and completely smashing a 2nd class carriage to pieces. The guard of the goods' van was found dead in his van, frightfully mangled. Traffic on main line interrupted for about 3 hours. But as the fatal occurrence took place close to a loop line, the traffic for the time being was continued by making a slight divergence from the main road.

Another accident of a singular nature occurred, 20th August ult., on the Windsor and Reading Branch of the London and South Western Railway. The Windsor express train, 11.25 a.m., consisting of seven carriages, 30 passengers, and break-van, had reached within one mile of Feltham Station, when suddenly the engine left the rails, dragging with it the whole of the train for about 100 yards; it tore up metals and chairs, when it diverged to the left, and, after ploughing its way into a stubble-field, the engine and carriages fell over with a fearful crash, five of the carriages being smashed and broken. The passengers escaped with but slight injury.

Rails for India lost.—Intelligence has been received of the total wreck, near Bombay, of the ship *Natalie*, from Glasgow, laden chiefly with railway iron for the former port, by striking on the reef during a terrific south-west gale driving shorewards. Captain and 13 of the crew rescued by the *Alma*.

Defective Couplings.—Near East Retford, on the Manchester, Sheffield, and Lincolnshire, and Great Northern Junction, an excursion train, consisting of upwards of 40 carriages, had nearly arrived at the Thetford Junction, when 2 of the carriages, from some cause yet unexplained, went on to the main line of the Manchester, Sheffield, and Lincoln, whereby the couplings were broken; the 2 carriages were thrown off the rails, proceeded about 30 yards amongst the gravel and ballast, and then went over with a crash. The bank at this place, over Ordsall Lows, is 21 feet high; and, had they fallen a foot or so further East, the passengers must have been precipitated down the embankment. Fortunately, however, no lives were lost, nor serious damage, beyond alarm and a few slight injuries, done.

By Railway—Accidents in the Grand Duchy of Baden and in Prussia, in six years' working, there were only one out of 17,514,977 persons killed; and 1 out of 1,154,331 wounded.

For stopping a Railway Locomotive in the midst of its speed almost instantaneously, a new apparatus, invented by M. Rigolier, was recently exhibited at Lyons. Its power was acknowledged to be superior to that of any similar contrivance hitherto in use, and there is every probability of its becoming employed upon all the lines in France.

An open Drawbridge.—Recently the down express train from London, due in Haverford West 6 p.m., when about 100 yards distant from the drawbridge over the Cleddau, found that the bridge was, by some unaccountable negligence, raised. The driver instantly turned off the steam, and all the breaks were instantly applied, and, most fortunately, the engine was brought to a dead stand when within a single foot of the opening. Another revolution of the engine's wheels would have precipitated the train into the river.

Shunting Carriages—Defective Points.—On the North British Railway, 7th September ult., near St. Margaret's Station, some empty carriages were being shunted; one of them went off the rails, it is supposed, from the points going wrong, and went on the opposite rails. Before they could be removed, the express train from London came up, and a collision took place, by which the engine of the express train was thrown off the line, and the empty carriages much damaged. All the passengers escaped unhurt; the fireman sustained some slight injuries, and for a time the line was closed.

Railway Accidents.—From the official tables for 1858, it appears, that one passenger in 5,353, 603 has been killed, and one in 332, 204 injured, from causes beyond their own control, during the year 1858. The proportion of killed and injured, from similar causes, to the number who travelled, was one in 312,794.

Of Railway-Accidents in France.—The French Government have ascertained that since the first opening of railways in that country, the statistics have been as follows:—Number of passengers killed, as compared to the numbers carried, 1 out of 1,955,555; of wounded, 1 out of 496,551; and that by the diligences, from 1846 to 1855, the number of killed was 1 out of 355,463; and of the wounded, 1 out of 29,870.

In Belgium, according to official documents, there was 1 in 13 years and a half; 1 killed out of 8,861,804, and about 1 wounded out of 2,000,000.

Defective Fastenings to Carriage-Doors.—Near the Portslade Station the guard of a short train from Littlehampton to Brighton turned the handle of a door; but the door was not shut, and shortly afterwards, on leaning against it, it gave way, and he was precipitated upon the embankment. The engine was immediately sent back from Brighton, and he was found not seriously hurt, but very much shaken. Last month we had to notice an accident arising from defective door-fastenings to railway carriages. The subject needs enquiry, and the present system requires improvement.

Damage by Rain to American Lines.—On the Galena Railway, one of the three Great Western (of America) lines, according to the "Engineers' Report" for 1858, the works on the line, owing to the heavy rains, have suffered severely, the effects having been "disastrous in the extreme"—culverts undermined, fences swept off, and embankments washed away. The large culvert spanning the Kinni Kinnick gave way, and about 200 feet in length of an embankment, 40 feet high, was washed out. A truss-bridge, of 100 feet span, with approaches of trestle-work, is now erected over the gap. The bridge rests for the present, upon temporary trestle-bents. It is designed to build stone abutments for its support.

American Railway-Accidents.—The United States *Economist* thus sums up the usual predisposing causes of American railway-accidents, namely, "rusted boilers, ricketty cars, rotten bridges, ruinous culverts, sprung rails, sinking road-bed, and damaged switches."

TELEGRAPH ENGINEERING.

The London District Telegraph Company have 11 district stations in progress, and the 89 sub-district stations are expected to be opened by the 1st of January. The lines completed consist of 6 miles underground, and 3½ miles overhouse; and the lines in progress consist of 5 miles underground, and 8 miles overhouse. The wires are to be worked by females; those who can manipulate three or four words a minute will be paid 6s. a week; 8 words, 8s.; and after that, 10s. per week. At present the company have 45 young persons under instruction by a competent instructress. By the intended rules, any male clerk found talking to any of the female clerks "will be subject to instant dismissal."

The Atlantic Telegraph has been recently examined and experimented upon (by order of the directors) by Mr. Webb, to endeavour to ascertain the present electrical and mechanical state of the cable. The official report, dated from Valencia, treats of the observed phenomena under the heads of "resistance" (maximum and minimum), "effects of reversed currents," sealing up of the "fault," by a copper-current, use of a zinc-current, variation of fault (resistance), by reversal of current, return currents, &c. The upshot, however, of the experiments being that "a serious fault exists about 263 statute miles from Valencia (measuring along the cable), and that the cable, between that spot and the (Irish) shore, is comparatively perfect." The report concludes by declaring it probable that if the fault which exists on the Irish coast, and which, very likely, forms the principal cause of leakage, could be removed, the insulation would be so far improved as to render the cable again available for signalling, provided the fault which is said (by those who have tested it from Newfoundland) to exist in Trinity Bay, be also repaired.

A Telegraph Line from Singapore to Australia is to be established under the joint auspices of the English and Dutch Governments, who have come to an understanding upon a system of telegraphs which will unite India with Australia, and, eventually, with China. The arrangements between the two governments are:—1. That the Indian and Imperial governments shall connect India with Singapore. 2. That the Dutch government shall connect Singapore with the south-east point of Java. 3. That the Australian government shall connect their continent with Java. The cable for the Singapore-Java section is on board the *Bahiana*, and will be laid during the month of November. The Indian-Singapore section is to be laid by spring next, and the connexion with Australia will, it is believed, be completed in the course of next year.

Isle of Man.—Telegraphic communication with England has now been secured, the cable for this purpose having been laid (26th August last). It was constructed by Messrs. Glass, Elliott, & Co., and measured 35 miles in length, but it was only found necessary to pay out 33½ miles. The steamer *Resolute*, having the cable on board, and accompanied by the steamer *Mona's Queen*, left point of Ayr, at the extreme north of the Island, between 11 and 12 o'clock, and reached St. Bee's Head, on the coast of Cumberland, at ½ past 5 p.m. After being landed, the wire was tested, and the insulation found to be good. Paying out of cable, superintended by Mr. F. Webb, and operations at St. Bee's under direction of Mr. G. G. Newman, Engineer of the Electric Telegraph Company, at Manchester. The lines of the Isle of Man Telegraph Company, are placed in connection with those of the Electric and International Company, and, consequently, are in communication with England, Scotland, and the Continent. There are two stations on the Island—namely, at Ramsey and Douglas.

The Submarine Telegraph Company's Cables, from Dover to Calais, and Dover to Ostend, which have now been laid down between seven and eight years, have cost for repairs (damage solely caused by anchors of large ships) £4546 15s. 5d. This comparatively small amount is adduced as very strong evidence of the superiority of heavy cables wherever there is the slightest risk from anchorage. Their submarine telegraph lines between Folkestone and Bolougne, and between the coast of Norfolk, Heligoland, and Denmark, lately completed, are in perfect working order. The Company possess 10 efficient conducting wires between England and France, besides six to Belgium, and five to Hanover, Denmark, and the North of Europe. Between the Channel Islands and the French coast the cable will consist of one conducting wire, which is now being manufactured, and will shortly be laid down. New stations at Embden, Heligoland, and Westerhever, (in Denmark) have been established, or are in process of completion.

The Number of Messages sent through the Submarine Telegraph Company's wires, in the half-year ending June last, amounted to 63,005, shewing an increase of 13,627 messages over the corresponding period of 1858.

Telegraphs in Japan.—By recent advices (to 5th June) by China mail, we learn that the Japanese Emperor, after the first experiments with the electric Telegraph, ordered the construction of lines connecting the towns of Jeddo, Nagaski, Semoda, and Hakodadi.

The Recent Aurora Borealis, visible in this country about midnight of the 28—29th August ult, is asserted to have exercised in France a remarkable influence on the telegraph wires, which, simultaneously with the appearance of the Aurora Borealis, ceased to act. From seven in the morning to nine, it was impossible to make them convey messages; they rang the signal-bells furiously, and were a prey to violent electrical currents. These phenomena gradually subsided. Similar disturbances of the electro-telegraphic currents were experienced in this country. On the 28th August (Sunday) the deflections of the needles at the telegraphic offices were (according to the Manchester Courier) strong and erratic. Subsequently, the electricity was so abundant that the action of the wires was interfered with, and no information could be obtained for the newspaper offices, nor were private messages transmittable. The needles, instead of being obedient to the ordinary magnetic current, were violently agitated and deflected by the electricity of the atmosphere, so that the telegraph clerks could only decipher here and there a word or two of a sentence. These phenomena occurred in connection with the wires of both the Electric and Magnetic Telegraph Companies, and were not merely local in their manifesnation, but interfered with messages from London, Liverpool, Birmingham, and more distant places. So great a disturbance of the electrical currents has not been known for many years—scarcely since the introduction of electrical telegraphing.

Telegraph Traffic between France and Spain.—The French Government, through the *Moniteur*, has recently ratified the declaration signed between France and Spain, relative to the charge for telegraphic despatches exchanged at the frontiers of the two countries, as likewise the the acceptance of the accession of the Queen of Spain to the Telegraphic Conventions of the 30th June, and 1st September, 1858.

Calcutta.—Barrackpore Telegraph Line.—On the night of the 26th July last, a cyclone passed over Calcutta, and the following morning every telegraph line was interrupted. The strongest constructed were swept away, especially for some miles along the Barrackpore Road, where large trees fell at various places, destroying the posts and wires. Every available hand was at work, repairing the damage done to the lines.

MARINE STEAM ENGINEERING, SHIPBUILDING' &c.

The Coaling of Steamers, hitherto an operation requiring great labour and delay, is now, by late mechanical contrivances, faciliated to a surprising degree. Thus, by means of the steam Cranes of the *Great Eastern*, that enormous vessel, which, under the old system, would have required at least a month or even six weeks to coal, can, as we have now seen, have that operation performed, to the extent of 10,000 tons, in less than 48 hours.

The Steam Freight and Passage to India, as likewise steam communication with China and other parts of the East, has, since 1851, continued constantly on the increase. Even as late as 1851 steam communication with the latter portions of the globe was still in its infancy. There was then only one mail service a month. In 1852, this was made a fortnightly communication; and now, although there is one a week, the demand for steam freight and passage is very greatly in excess of the supply. In 1851, when the new system was first originated, the trade to the East and outward tonnage only amounted to 452,852 tons. In 1858 it amounted to 946,503 tons, or nearly double, The value of this export trade has, in the same short interval, increased in the same immense proportion, being now, with Australia, £10,000,000 per annum, and with India, £18,000,000, exclusive of bullion. The monthly clearances of vessels to the East, are about 80,000 tons.

The Indus "Steam-Flotilla," the Oriental Inland Steam Company, at their recent half-yearly meeting, report that the trains despatched from the country last autumn, had arrived in India in safety, and, therefore, a managing director was despatched to Kurrachee to see the vessels fairly started on the river. One steamer, a passenger barge, was launched immediately, and one cargo barge; these vessels were tested under weigh in the harbour, in a connected state, and were found to act satisfactorily. The mouth of the Indus, which, at present, forms the navigable entrance to the river, is a considerable distance from the harbour, and, the Monsoon being then near at hand, it was found impossible to wait for the completion of more barges, as in consequence of the heavy sea during that period, between Kurrachee and the mouth of the Indus, the passage across, in boats of this description, would have been impracticable. The steamer proceeded up as far as Schwan, a distance of about 330 miles; but the European pilot died from sun stroke; the crews sickened with the intense heat of the weather; and the power of the steamer having been found inadequate to propel her with sufficient speed against the stream, which was found to be stronger than was hitherto represented, it was resolved to return to Gioree (whence she had started), with a view of perfecting arrangements for another trip. The favorable inauguration, therefore, of the Company's enterprise, has, from these causes, been unavoidably deferred. Two additional trains, of greater power and capacity than the last, have been ordered, and are in a forward state of completion.

The "Orlando" large Steam Frigate, the first of her class, is understood to be brought into existence in imitation of the *Niagara*, and similar ships, by the Government of the United States. Their peculiar advantage is, that, with about the same tonnage as an ordinary ship of 100 guns, having auxiliary steam-power, they possess superior means of propulsion, which counterbalance, to a great extent, the difference of armament: while the extra speed gives them many advantages over other ships, although carrying more metal. Her cost will be £200,000, viz., construction, upwards of £90,000, remainder being for her machines and outfit. Dimensions—length, 337 feet; between perpendiculars 300 feet; breadth, 52 feet; for tonnage, 51 feet 6 inches; length for tonnage 264 feet $4\frac{1}{2}$ inches; breadth, moulded, 50 feet 8 inches; in depth of hold, 19 feet 10 inches; tonnage, 3,727 tons; she has considerable "sheer" (rise of deck) forward, more than usual in ships of war. Mainmast, 97 feet 9 inches long, and 37 inches diameter; foremast, 93 feet 6 inches, by 24 inches; main and foremasts, 65 feet by 22 inches; bowsprit, 62 feet; main-yard, 96 feet; topsail-yard, 71 feet; weight of all her spars, 80 tons 2 cwt. Her lower rigging is of wire, the use of which has been recently introduced into all steamships in Her Majesty's service. Armament—on main deck, 58 guns, 65 cwt. each, 8-inch bore, for discharging hollow shot and shell; on upper deck, 12 of 95 cwt. 8-inch bore, for solid shot. Length of screw-shaft, 86 feet 8 inches; engine room, 30 feet 9 inches long; coal bunks, 39 feet 2 inches; passage to stoke-hole, 10 feet wide; stoke-hole, 10 feet wide and 60 feet long. Total length for machinery, coal, &c., 219 feet 9 inches. Her (pair of trunk) engines, by Penn and Son, of Greenwich, 1,000 horse power; diameter of cylinder, 100 inches; diameter of trunk, 38 inches; length of screw, 20 feet; length of fans, 4 feet 6 inches. Pitch of screw can be altered from coarse to fine, that is from 20 feet 6 inches to 35 feet 6 inches. Weight of fans (metal), 17 tons 16 cwt.; contents of boilers (water), 164 tons; tubes, $2\frac{1}{2}$ inches diameter, in number 3,520; length of each tube, 6 feet 8 inches; furnaces, in number 32; bars, number in furnaces, 1,854; diameter of telescope funnels (two), 6 feet 8 inches; height from deck, 30 feet; coal in boxes, 886 tons; estimated consumption, when exerting full power, nearly 6 tons per hour, or per day, 150 tons; being fuel enough, if under full steam, for six days.

The "Irrestible," new Screw Steamer, 80, at Chatham, is finished, and waiting to be launched (fixed for the 29th October inst.).

The Steam Navigation on the Tigris, organised by an English Company, is in full activity. A new steamer, the *Bagdad*, has commenced plying, and has numerous passengers.

The Screw-Steering. Nearly all vessels, propelled by the screw, would describe circle, when under steam only, if left to themselves. The *Mersey*, on her first trial, had a considerable tendency to port; this was obviated by cutting off a corner of the fan. The *Doris*, on her trial, carried her helm $2\frac{1}{2}$ points to port; but when the fore-corner of the fan was removed, she carried her helm much better. There is some difficulty in steering the *Orlando* when under full-steam; and many hawls are then necessary; and if the helm is placed hard-a-port, it takes twelve minutes to put her round three quarters, and sixteen minutes to complete the circle. Under half-steam, she goes round in half the time, and in less than half the distance.

"Cheese-Coupling" for Screws. In the *Orlando*, the thrust of the screw instead of being inside, as customary, is taken from the outside; and the cheese-coupling pushes against lignum vitæ, fitted in a brass washer and secured to the sternpost. This alteration has been adopted successfully in several smaller ships, fitted by Messrs. Penn and Son the patentees, as it prevents the necessity of internal bearings, and economises much internal timber and iron.

The "Shadia" Turkish Line-of-Battle Steamer, fitted with a screw propeller, at Devonport Dock Yard, was (31st August ult.) taken out of Keyham Basin, and placed alongside the hulk.

A new War Schooner, the "Maria Anna" is now building for the Portuguese Government by Mr. Scott Russell, and is so far advanced that the *Sagres Corvette* was to leave Lisbon for Greenhithe on the 10th September inst. with a crew for the new vessel.

Lubricating Bearings, &c. The quantity of oil which will be required for six months' consumption in the *Orlando* Screw, is estimated at 1,000 gallons, and the amount of tallow at 53 cwt.

An Experimental Trip with the "Orlando," Screw-Frigate, was made (22nd August) outside the Plymouth Breakwater, under supervision of Admiral-Superintendent Sir Thomas Pasley. The results of the different trials at the measured mile were as follows: First, 4 min. 26 sec. 13·534 knots; second, 4 min. 46 sec. 12·587 knots; third, 4 min. 30 sec. 13·333 knots; 4th, 4 min. 48 sec. 12·500 knots; fifth, 4 min. 27 sec. 13·483 knots; sixth, 4 min. 33 sec. 13·187 knots. Average rate estimated by the engineer 132 16ths: revolutions, 50 per minute; pressure, 20lbs.; indicated-power, 4,200 horses. Rate of speed not equal to expectation. With some contemplated alterations in her screw, she may possibly make $13\frac{1}{2}$ knots, but much more was anticipated. At the first trial of the *Mersey*, she made 13·4 10ths, when the engines exerted an indicated power of 4,000 horses. While under steam, the *Orlando* shook and twisted considerably, especially in the extremities, and her top-gallant mast and bowsprit were vibrating constantly; movements which, under steam and canvas combined, it is understood, will be compensated. Her present draught is, aft 22 feet 8 inches, forward 21 feet (spars, rigging, guns shot, coal, and water, (150 tons) on board, but no provisions or crew). Estimated draught, aft 23 feet, forward 21 feet. Designed by the Surveyor to the Navy, Sir Baldwin Walker, and built by Mr. Oliver Laing, at Pembroke.

Improved Rail Coal Boxes for Steamers. In the *Orlando* the coal boxes in the wings are 135 feet long, and are furnished inside with railways for despatching the contents. Over head, each side the stoke-hole, there are also single rails which receive wheels attached to iron brackets, for transmitting fuel to the fires. Without appliances of this kind, it would be impossible to keep up the powerful heats required to drive the *Orlando's* engines.

Ventilation of Steamers. The hoisting of sails in fast sea-going steamers is generally resorted to, principally for making a strong draught down into the engine-rooms and furnaces.

Additions to the Cunard Steam Fleet. At a meeting of the Mersey Dock Board, 1st September ultimo, the local principal of the Cunard Company intimated that his firm were building a paddle steamer larger than the *Persia*; and that, in addition to this, they were preparing seven other steamers, intended for the Liverpool trade.

The new Steamer Route to Ireland. The *Adela* new steamship, of the Glasgow and South-Western Railway Company, made (2nd September ult.) her first voyage from Ardrossan to Belfast. It was a most rapid passage, considering the roughness of the weather, and the newness of her machinery, viz., to Blackhead, 4 hours; Holywood Lighthouse, 4 hours 50 min.; Belfast, 5 hours, 18 min. The steamer leaves Ardrossan immediately on the arrival of the Ayrshire Express-train from Glasgow. On her return voyage, afternoon of 2nd September ult., left Belfast at 4·5 p.m., (or 4·30 Greenwich time,) and arrived at Ardrossan Quay at 9·57. Passengers forwarded thence per special train, reaching Paisley at 10.56, and Glasgow at 11·10 p.m., thus accomplishing the whole journey, viz. 84 miles of sea, and 32 miles of railway, in 6 hours and 40 minutes.

Paddle Engines of the Great Eastern, designed and built by J. Scott Russell. Oscillating nominal horse power, 1,000; number of cylinders, 4; diameter of each cylinder, 74 inches; length of stroke, 14 feet; strokes per minute, 14; weight of each cylinder, including piston and piston-rod, 38 tons, or more than seven times the weight of the great bell of St. Paul's, engines furnished with all the latest improvements, including lubricators, registering tell-tales, engine-room clocks, and guages of every description. Permanent indicators to each cylinder; all the heavy pieces of forged iron in the machine, forming the heaviest and most important wrought-iron work ever manufactured, were executed by the Lanefield Forge Company. Forgings relating to the paddles, are of following dimensions.; 2 paddle-cranks, each 7 feet between centres, and weighing, when forged, $11\frac{1}{2}$ tons, when finished, 7 tons 4 cwt.; paddle-shafts, each 38 feet long, and weighing 30 tons; intermediate cranked shaft, depth of throw, 5 ft. 1 in., thickness, 2 ft. 9 in., greatest diameter, 2 ft. 7 in., length over all, $21\frac{1}{2}$ ft., weight, 31 tons; 2-friction-shafts, for disconnecting paddles, each 10 feet inside diameter, and 15 inches thick, weight of each, 9 tons 12 cwt. Building of paddle-engines commenced about same time as ship, originally put together in erecting-shop; time thus occupied, about 12 months; were then taken down and erected in ship; actual time thus consumed, about four months.

Japanese War-Steamer. The Emperor has decided on transforming his fleet. He already possesses six steam war-junks. One of them, the *Niphon*, has started on a voyage of circumnavigation. Her engine is of 350 horse power, and of American manufacture. The crew consists entirely of Japanese sailors, who show great aptitude in the management of steam engines.

British Mercantile Steamers.—Belonging to the Port of Hull, at the close of 1858, there were 68 steamers, registered (aggregate) tonnage 18,364 tons; to Bristol, 37, of (aggregate) tonnage, 4,769.

The "Immaculate Conception" steam vessel, built for His Holiness the Pope of Rome, at the Thames Iron Works, Blackwall, has been forwarded to her destination. She has been fitted up in a most superb manner. and is intended for navigating the Adriatic.

The "Windsor Castle," 116, Screw Steam Ship, proceeded, 7th September ult., through Plymouth Sound for trial, at the measured mile, outside the Breakwater. Distance covered six times, with a mean result of above 11 knots; Engines (Penn and Son) of 500-horse power, nominal, revolutions, $68\frac{1}{2}$; Steam, 20lb.; vacuum, 26; draught forward, 18 ft. 8 in.; aft., 21 ft. 10 in.; steered well, and engines reported in very good order.

The "Clio" Steam Corvette on her trial, 7th September ult., averaged 11 knots; no hot-bearings, no priming. Trial highly satisfactory to dock yard authorities.

The Fire Stokers in our Steamers that traverse the Indian Ocean, are generally of Eastern-African race of the breed of the true woolly-headed, negro, remarkable for their physical strength of build, and athletic proportions.

The "Galatea" Screw Corvette, 26, launched at Woolwich, 14 September ult., length between perpendiculars, 280 ft.; length of keel for tonnage, 245 ft. 8 in.; extreme breadth, 50 ft.; ditto for tonnage, 49 ft. 6 in.; breadth moulded, 48 ft. 8 in.; depth in hold, 19 ft. 4 in.; burthen in tons, 3,202; engines, 800 h.p.; number of crew, 475 men; her screw-machinery, by J. Penn and Sons, of Greenwich. Launched from off the slip on which she was built, by means of four hydraulic rams; after the launch she was removed into the outer basin, to be fitted with her screw-machinery.

A Steamer for Navigating the Straits of Magellan (where a new colony from the North of Europe is about to be established by the Chilian Government) is to be purchased, destined to place the new colony in more frequent communication with Chili.

The "Great Eastern" finally started on her first trip, from her long-occupied position in the river off Deptford, at 35 minutes to 7 a.m., of the 7th September ult., aided by four government steam-tugs from Woolwich, made fast to the fore and after part of the ship. The steam in her boilers was fully up, and both the paddle and screw-engines were occasionally worked. Mr. W. Atkinson, the river pilot, had charge of the ship as far as the Nore. At Blackwall Point, opposite the Gun Shoal, the wind, and the set of the tide together, drove her bows too much in shore, and it required the united power of five steamers to pull the ship's head round into mid-channel. At a quarter to 9 o'clock she passed Blackwall Pier; at 9·15 a.m. she steamed, with both paddle and screw-engines at work, past the Royal Dock Yard, on her way to her anchorage at the Nore, where she arrived safely at 23 minutes past 1 on the following day, having anchored off Purfleet, in the upper part of Long Reach, during the preceding night. At 9 a.m. resumed her progress down the river. September 8th, steam-tugs cast off at the Chapman's Head at the top of Sea Reach, and ship left to her own control; more steam put on, not to test her power, but to give her good steerage way, and move her engines easily; on passage down the river, her paddle-engines had never moved more than from four to six revolutions per minute; and the screw at from twelve to eighteen; but now when not employing two-thirds of her actual sea-going power, she ran from the Lower Hope Point, to the Nore Light-Ship (15 statute miles) in two minutes under the hour—equal to 13 knots or 15 miles per hour. Engines worked with perfect ease: entire absence of vibration, or "swell" in her wake. Reached Nore Light at 12·30 9th September ult., and anchor let go in 8 fathoms, with 45 fathoms from the hawse-hole; 10th September ult., anchored at Portland 9·50 a.m.

The purchase of the Collins Line of Steamers (advices from New York, August 25th ult.) has been completed. The Panama Railroad Company's Directors, on the previous day, confirmed the action of their Committee in this affair. The Pacific Mail Company had already done so. The ships will be put into a new Company, to run in the Californian trade, and will commence their trips on the 5th October.

Fifty large Steam-Transports, each to contain 3,000 men, have been ordered for construction by the French Government.

The "Sphinx," 6, Paddle, commenced masting in the Steam-basin at Portsmouth, 8th September ult.

Cheese Coupling for Screws. In the *Orlando*, the thrust of the screw, instead of being inside, as customary, is taken from the outside, and the cheese-coupling pushes against lignum vitos, fitted in a brass washer, and secured to the sternpost. This alteration has been adopted, successfully, in several smaller ships, fitted by Messrs. Penn and Son, the patentees, as it prevents the necessity of internal bearings, and economises such internal timber and iron.

MILITARY ENGINEERING.

The new American Riflen Cannon, the invention of General James, if the official accounts received in Europe of their performance be authentic, bid fair to rival the results of modern improvements in that direction recently made on this side of the Atlantic. from the official report of the Board who superintended the trials of some late experiments at Chicopee, Massachussetts, we learn that the guns examined were a 6lb. bronze cannon with a 3·80 in. calibre, and rifled in 15 grooves, or 12-pounder 4-inch calibre, and the same number of grooves. In both instances, the twist in rifling was equivalent to one turn in 60 feet at the beginning and ending in 1 in 20. The projectile, designed by Genl. James for these guns, is a cast-iron cylinder pointed by a solid conoidal head, the diameter being only ·02 of an inch less than the bore of the gun, and the length twice the diameter of the calibre. The cylinder retains its full diameter for a quarter of an inch of its length at each end; for the intermediate length, the diameter is reduced half an inch, forming a recess in its body, which is filled by a compound of canvas, sheet-tin, and lead. The base of the cylinder has a central cavity or opening of 1·5 inch deep. When the charge is fired, the gas evolved by the burning of the powder, in its efforts to eject the projectile and to escape from the gun, is forced into the cavity, against the compound filling, which is thereby pressed into the grooves of the bore, and by its firm hold in them, the rotary motion is imparted to the projectile. The greased canvas wipes the rifling clean, and leaves the bore in condition readily to receive the next charge, and also serves to protect the bore from injury. Results of experiments: in one instance 18 shots were fired a mean distance of 674 yards, at an elevation of 1 degree, the powder weighing $1\frac{1}{4}$lb., the projectile $12\frac{3}{4}$lbs.; the deviation being only 4 inches to the right of centre, and $\frac{1}{2}$ an inch above it. On reaching ground, the missile was buried 5 feet in compact sand. In another instance, a shot was fired 2,050 yards at an elevatyn of 5 degrees, and passed about 5 feet above the top of the hill, towards which it was directed, continuing its flight many hundred yards beyond the hill. The Report adding, "It is almost certain the ball went 4 miles."

Conversion (of Ordnance) from Smooth to Rifle-bore.—The guns employed in the service, which present a surface at the bore fit to secure and maintain the grooves, and which possess a body of sufficient textile strength to resist the explosive power required to expel, with safety, the heavy shot now in use, can now, it is ascertained, be rifled. Recent successive experiments at Shoeburyness, with some of the guns which have undergone conversion from the smooth to the rifled bore (a conversion hitherto considered impracticable) attest this fact. The first gun submitted to trial was an 80-pounder on Sir Wm. Armstrong's original plan. The second, an ordinary 32-pounder service gun, rifled on his plan adapted for elongated cast-iron shot or shell. They were transported from Woolwich Arsenal without preliminary proof or test, and were fired over a range of 3,400 yards. The target was 6 feet square, into which every shot, namely, 6 rounds from each gun, penetrated with terrific and certain aim.

At the Rifled Ordnance Department at Woolwich, 100 Armstrong guns for service during the present year, the number stipulated for with Sir William, are already in form, and will be completed and delivered, if necessary, long before the prescribed period.

A Long Range.—Recently the *Toulonnais* announced that experiments are being made, at the Island of Hyères, with a cannon on a new model, which carries 12,000 yards.

American Estimate of the relative Merits of the "Armstrong" and "Genl. James's" Rifled Guns.—*The New York Journal of Commerce*, commenting on the latter invention, says, that according to the laws of projectiles laid down in the *Ordnance Manual*, and which have long been established, as was supposed, beyond power of refutation, the range of a 7lb. shot at 5 degrees elevation, and 1¼lb. powder, is 1,523 yards; but in the example afforded of the James's gun, a ball 12¾lb., with the specified quantity of powder, has gone between 3 and 4 miles. Mr. Armstrong claims to have thrown a ball 5¼ miles with 6lbs. of powder, employing an area or calibre of 3¼ inches, which is a result of 55-100ths less favourable than that obtained by the experiments at Chicopee. According to the latter, any gun [here, we presume, any James's gun is meant.—*Ed. Artz.*] of a calibre equal to Armstrong's, will throw a ball, with less than half the powder, the full distance attained in his practice.

The 3-gun Battery, on the new line of coast-defence fortifications, between Portland and Weymouth has been completed by the 18th Company of Royal Engineers, who have now commenced the erection of a much larger battery, to be mounted with 50 of the long-range Armstrong guns.

BOILER EXPLOSIONS.

A fatal Boiler Explosion occurred recently in one of the Cornish mines. The boiler belonged to the pumping-engine at Levant Mine. The engineer was killed by the explosion.

The Boiler of the French Gunboat "Aigrette," stationed in the Adriatic, exploded recently, killing and wounding 7 or 8 men. Rest of crew saved, being close in shore.

The Boiler of the "William and Mary" Steamer, on the Tyne, exploded recently, off Hebburn Quay, tearing up the decks, and making a complete wreck of the vessel. There were 3 men on board, 1 of whom perished. The accident is described as having been solely caused by the recklessness of the men navigating the steamer, who, at the time of the disaster, were racing against the *Louis Crawshay*, steamer, belonging to a new steam-packet company, who have lately commenced running between Newcastle and Tynemouth. Just previously to the explosion, a fearful pressure was purposely put on the boiler, and the crew of the William and Mary were puffing off steam at the *Louis Crawshay*.

At the Great Lewes Sheep Fair, afternoon of 20th September ult., the boiler of a 4-horse power engine, used for driving chaff-cutting and threshing machines, and which was standing at some little distance from the booths, sud-denly exploded, killing 4 persons on the spot, and severely injuring several others; also killing a colt and 2 sheep. The engineer in charge was found lying dead near the engine, which was entirely destroyed, so as to preclude the possibility of ascertaining the cause of explosion. End of fire-box completely driven out; safety-valve blown off; skid-pan found fifty yards from the spot; upper portion of funnel thrown to a great height, and large pieces of iron scattered about, as far off, it is said, as a quarter of a mile.

The "Fury" Steam-Tug, of Bristol, exploded about 4.30 p.m., 21st September ult., in Kingroad, whilst lying alongside the barque *Ant*, bound for Quebec. The captain of the *Fury* was on board the *Ant* when the explosion occurred, and is unable to assign any cause for it. Steam-tug literally blown to atoms. Of the crew (5 in number) fireman missing, as also the engineer; a boy blown on board the *Ant;* mate picked up on a piece of the floating wreck comparatively uninjured.

APPLIED CHEMISTRY.

Hydrochloric Acid in Road-making.—Experiments are now being made, and, according to *Galignani*, with success, at Lyons, for laying the dust in public promenades, and otherwise improving large macadamised roads. A chymist of Lyons, having accidentally spilt some hydrochloric acid on a terrace, found that it maintained the spot on which it fell in a state of permanent moisture. This led him to think that, by watering the streets with water, tinctured with this acid, the dust on large macadamised roads might be laid, or rather prevented from rising. Experiments were first made on the Cours Napoleon, between the Rhone and the Perrache Station. The success is said to have been complete; the carriage-way having now been several months free from the dust. Another experiment is being made on the Place Bellecour. The acid from one of several deliquescent salts, which attract the moisture of the air, especially during the night.

Silicatisation—A new Mastic for Teeth, has been invented by M. Sorel. It consists of 1 part of glass in powder, and 3 parts oxide of zinc, both reduced to an impalpable powder, and the oxide of zinc should be free from carbon; the powder is to be mixed with a solution of 50 parts of chloride of zinc and 1 of borax, so as to form a paste, which, in the course of a day, becomes as hard as marble. If the ingredients be pure, the mastic will be perfectly white. A little ochre added to the powder will produce the natural colour of the teeth. The tendency of the mastic is understood to be the result of a true silicatisation.

WATER SUPPLY.

At Hackney 3 Drinking Fountains, attached to a handsome clock-tower, are about to be erected, by private subscription, on the spot known as "the Triangle." Tower to be 45 feet high, with the 3 drinking fountains at alternate angles, and troughs at a short distance. The clock will have 3 illuminated dials, 4 feet in diameter. The water will be supplied from a well, to be sunk immediately under the centre, and to be raised by the machinery of the clock.

A novel Feature in Drinking Fountains is the introduction, as in the case of the recent one at Grey-Coat Hospital, of a barometer and thermometer, which are placed one on each side of the fountains.

In Marylebone the first Drinking Fountain has been opened with much ceremony. The site is the ancient gate, in front of the Infirmary of the Marylebone Workhouse, which has been bricked up for several years in the Marylebone Road. The fountain is understood to have been erected at the expense of a benevolent lady, who did not wish her name to transpire.

Lisbon—The Works of the new Water Company (advices to 27th August last) have at length commenced, after remaining in abeyance about 3 years. At present, the only means of water supply is the barrel of the water-carrier.

In Edinburgh the "Sinclair Drinking-Fountain" (See Notes and Novelties for March last) has at length been opened. The structure is at the extreme end of Princes' Street, at the junction of the Lothian Road and Rutland Street. It combines the drinking-fountain for human beings with troughs for horses and dogs, and appears to be very popular.

In the Horseferry Road, Westminster, a handsome free drinking-fountain was opened 5th September ult., for public use at the point of junction of Strutton Ground, Great Peter Street, and Grey-Coat Place. It is let into the wall of the Grey-Coat Hospital. White marble, enclosed in an oval bronze scroll formed of foliage and figures. In the centre, a shell carved in white marble, from which the water flows in a continuous jet.

The Public Baths of Liverpool, where public baths and wash-houses were first established, appears to be constantly increasing in popular estimation. During the year ending 31st August last, the total number of bathers at the St. Paul's, St. George's and Cornwallis Baths was 317,846, being an increase of 45,071 over the preceding year. The receipts for 1858-9 were £6,103 16s. 2d.. being an increase of £684 14s. 6d. over the previous year.

A new Reservoir, for Halifax, is about to be constructed, in addition to the large ones of the Corporation already existing in the neighbourhood. It will be at Pellon, about a mile and a half from Halifax; to be a storage-reservoir for spring-waters (25,000 gallons per day) running to waste in the Ogden Valley; will hold some 28 millions and a half gallons, and will have 10 acres of water-surface. Superintendent, Mr. Stephenson, the Borough Engineer; Contractor, Mr. Daniel Skelton, of Moor End, to be completed for £10,500.

MINES, METALLURGY, &c.

Of Minerals there were, (in 1858,) 48,396,501 tons conveyed on railways in England, Scotland, and Ireland; for which conveyance £4,046,061 was received.

The Flooding of a Coalpit, (two lives lost,) occured recently, at Tipton, in South Staffordshire, in one of the pits belonging to Messrs. Bagnall & Sons. Two colliers were engaged driving a road in one of the pits, when the water that had accumulated in a disused pit rushed in upon them from the old workings, and they were quite overwhelmed by the torrent and drowned. It was some hours before their bodies could be reached.

In Newfoundland, Great Mineral Discoveries have, according to the *Quebec Chronicle*, been made. Specimens of copper pyrites, containing from 8 to 12 per cent. of metal, taken from a lode 50 feet in breadth (the ore being as valuable for sulphur as for copper) are spoken of. It crops out of the surface, and thousands of tons can, it is stated, be obtained at a very trifling outlay.

Lodes of Lead and Veins of Silver-Ore are also announced, on the same authority, to have been discovered in Newfoundland.

Mining Prospects (Iron and Coal) of India.—From the recent report of the Select Committee of Colonisation and Settlement (India), it appears that the developement of the coal and iron mines in that portion of the British possesions continues to advance. That railway communication has opened up the coal of Burdwan, and will open that of the Nerbudda district, bringing both into connexion with a supply of Iron. The coal of Nerbudda is stated to be peculiarly good, and especially adapted to the purposes of steam conveyance. Very good coal is also to be found in Assam, as well as iron-ore, neither of them far from the waters of the Bramahpootra. General Tremanhere speaks of large masses of iron seen projecting from the hills of Tennasserim, and of considerable deposits in Kumaou and Gwalior. Captain Haigh describes immense stores of iron-ore, as resting on the banks of the Wain Gunga, a tributary of the Godavery.

Gold in Kansas.—Latest accounts from this gold-region speak of new and very productive discoveries of the precious metal. The diggers in the Kansas goldfields have adopted a state constitution.

LIST OF NEW PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 30th July, 1859.

1768. A. B. Seithen, 6 Alpha-place, Caledonian-road—Cases or boxes.

Dated 1st August, 1859.

1778. E. Merrel, Little George-street, Minories—Apparatus for washing and cleansing.

Dated 4th August, 1850.

1800. E. J. Cordner, Derramore, Ireland—Application of kites to the saving of life and property from shipwreck.

Dated 5th August, 1859.

1808. R. T. Pattison, Daldorch, Ayr, Scotland—Dyeing certain woven fabrics.

Dated 8th August, 1859.

1822. J. Cunningham, Paisley—Jacquard weaving appartus.
1824. R. A. Brooman, 166, Fleet-street—Preventing incrustations in steam boilers.
1826. L. B. Olliver, 25, Boulevart St. Martin, Paris—Closing or stoppering bottles and jars.
1827. B. Baugh, Birmingham—Apparatus for finishing the edges of certain vessels formed from sheet iron.
1828. J. H. Johnson, 47, Lincoln's-inn-fields—An improved signal light.
1830. G. T. Bousfield, Loughborough-park, Brixton—Revivifying the scarlet colour of woollen cloth and embroidery
1832. J. B. Babcock, 35, Milk-street, Boston, U.S.—Umbrellas and parasols

Dated 9th August, 1859.

1834. Kenward, Sutton, Surrey—Constructing tubular steam boilers.
1836. J. Cannon, Billiter-street—Washing machines.
1838. C. L. J. Diericky, Paris—Scales.
1844. W. Williamson, High Holborn—Machine for drilling holes.
1846. J. H. Johnson, 47, Lincoln's-inn-fields—Destroying noxious exhalations.

Dated 10th August, 1859.

1850. T. A. Temperton, Manchester—Pipes for smoking tobacco
1852. G. Capper, Bidborough-street, New-road, Middlesex—Permanent way of railways.
1854. J. J. Speed, jun., Detroit, U.S.—Manufacture of pipes and hollow cylinders.

Dated 11th August, 1859.

1855. R. Heaton, jun., and G. Heaton, Birmingham—Coining machinery.
1857. J. T. Pitman, 67, Gracechurch-street—A composition applicable to the lubrication of machinery.
1858. W. Bouch, Shildon, Durham—Breaks and buffers.
1859. D. Hulett, 55 and 56, High Holborn, and G. Prudden, Shefford, Beds—Apparatus for the manufacture and distribution of gas.
1860. W. De la Rue, and Dr. H. Muller, 110, Bunhill-row, Middlesex—Treating Japan and other vegetable wax.

Dated 12th August, 1859.

1862. W. Clark, 53, Chancery-lane—Oscillating engines.
1863. A. Evaux, 206, Regent-street—Artificial marbles.
1864. W. H. Tooth, 3, Spring-terrace, Wandsworth-road—Cleaning or laying the dust of roads.
1865. J. Philp, Camden-town—An improved hobby-horse or child's exerciser.

Dated 13th August, 1859.

1867. D. Campbell, 7, Quality-court, Chancery-lane—Preparation of oils for medicinal purposes.
1868. J. Brown, 8, Exeter-place, Walham-green, Middlesex, —Improving false shirt fronts.
1870. W. Green, Kidderminster, W. Fawcett, and F. R. Fawcett, Wolverley, Worcestershire—Manufacture of rugs.

Dated 13th August. 1859.

1871. R. Clegg, Islington, and R. Fell, St. Ann's-place, Limehouse—Obtaining aerated fresh water from salt water.

8872. J. Stuart and W. Stuart, Musselburgh, Mid Lothiau, N.B.—Nets for fishing.
1873. K. Buhring, 45, Saint Paul's-road, Camden-town—Obtaining spring power.
1874. R. I. Watts, J. Offord, and J. R. Thomas, Plymouth.—Condensing smoke and products of coals and similar substances, and reducing them to useful materials.
1875. H. T. Lambert, America-square, London—Apparatus for the disengaging of ships' boats when lowered into the water.
1876. E. Sloman, Upper East Smithfield—An improved feed water and heating apparatus.
1877. J. R. Rostron, Edenfield, Lancaashire—Locomotive furnaces
1878. C. Mather, Salford—Machinery for stretching, drying, and finishing fabrics.

Dated 15th August, 1859.

1879. S. Harrison, 52, Stanhope-street, Clare-market—Broiling of chops or any other kind of meat.
1880. C. Kisky, King-street, Camden Town, and W. Jones, Howland-street, Fitzroy-square — Construction of sideboards.
1832. C. Glassborow, Girard-avenue, Philadelphia, U. S.—Pianos.
1883. J. Chanter, Bow-road, and D. Annan, Bow, Middlesex—Apparatus for supplying air to furnaces.
1884. N. Stone, 46, Lime-street—Machinery for cutting veneers.
1885. J. Poupard, Stratford, Essex—A certain plastic combination to be used for black-leading ironwork.

Dated 16th August, 1859.

1887. H. Batchelor, Newport, Monmouthshire—Steam and other motive power engines.
1889. W. Gossage, Widnes, Lancashire—Treatment of certain offensive liquids.
1890. J. C. Haddan, Bessborough-gardens, Pimlico — Wads for projectiles
1891. J. C. Haddan, Bessborough-gardens, Pimlico—Apparatus for rifling cannon

Dated 17th August, 8359.

1893. H. Medlock, 15, and 20, Great Marlborough-street, Westminster—Portland and Roman cement, kilns or furnaces.
1895. R. A. Brooman, 166, Fleet-street—Locks and keys.
1897. A. Yockney, Pockeredge, near Chippenham, Wiltshire Compound fatty matters with other substances for lubricating purposes.

Dated 18th August, 1859.

1899. J. Drabble, Orchard Works, Orchard-lane, Sheffield.—Sewing machines.
1901. H. J. Hyams, Holywell-street, Westminster—Construction of wet gas meters
1903. W. Wilson, Glasgow—Manufacture or production of bricks, tiles, and other articles of earthenware.

Dated 12th July, 1859.

1654. T. Wright, 9, George-yard, Lombard-street—Permanent way of railways.

Datec 30th July, 1859.

I770. H. J. Newcome, Shenley, near Barnet, Hertfordshire.—Apparatus for heating buildings.

Dated 1st August, 1859.

1782. Bassano, Brussels—Manufacture of artificial fuel, commonly called patent fuel.

Dated 5th August, 1859.

1802. B. Tweedy, Utrecht, Netherlands—Apparatus for consuming smoke in locomotive furnaces
1812. W. R. Drake, 46, Parliament-street, Westminster—Apparatus for conducting electricity in the sea.

Dated 9th August, 1849.

1848. J. Waite, Cheltenham—Making infusions for pharmaceutical purposes.

Dated 11th August, 1859.

1856. W. White, 34, North Audley-street, Grosvenor-square. A four-wheeled safety sociable carriage.

Dated 16th August, 1859.

1888. J. H. G. Rex, Regent's Quadrant — Construction of dwelling-houses or other buildings

Dated 17th August, 1159.

1892. J. Sidebottom, Waterside, Derbyshire. Power looms for weaving.
1896. S. Beardmore, 27, Albion-street, Hyde-park—Electric batteries.

Dated 13th August, 1859.

1898. W. Grimshaw, Lower Brighton, near Manchester, and S. Mason, jun., Manchester — Apparatus employed in washing and preparing flax
1900. A. J. Cann, Paris—Machines for breaking or crushing stones, minerals, or other similar materials.

Dated 19th August, 1859.

1904. P. Salmon, Glasgow—Locomotives.
1905. W. T. Henley, St. John-street-road, Clerkenwell—Machines for the manufacture of ropes and cables.
1906. S. Boult, Liverpool—Apparatus for retarding railway carriages.
1907r J. Jackson and J. Thorley, Worsley, Lancashire—Hoists for raising and lowering weights.
8908. J. Fowler, jun., R. Burton, and D. Greig, jun., Cornhill, E. E. Allen, Park Side, Knightsbridge, and W. Worby, Ipswich—Ploughs, cultivators, or tilling implements.
1909. H. W. Harman, Manchester—Steam boilers.

Dated 22nd August, 1859.

1911. E. Hardon, Stockport—Looms for weaving.
1912. W. Finegan, Belfast—Apparatus for lubricating machinery.
1913. D. Grant, Edinburgh—Wet gas meters.
1914. G. W. Petter and T. D. Galpin, Belle Sauvage-yard, Ludgate-hil—Printing presses.
1915. W. A. Verel, Macduff, Banff—Preparation of bones for manure
1916. R. A. Brooman, 166, Fleet-street—Apparatus for preparing and spinning fibrous materials
1917. J. J. O. Taylor, Mark-lane—Separation of silex and silicious matter from iron.
1918. Captain A. Spratt, R. M. Plymouth—Revolving pistols and other fire-arms.
1919. Hon. W. Talbot, Army and Navy Club, Pall Mall—An improved cigar lighter.
1920. H. Parkes, Birmingham—Manufacture of cylinders, tubular or hollow bodies of copper
1921. E. Abbott, Brunswick-square, Middlesex—Ordnance and fire-arms.
1922. O. Maggs, Bourton, Dorset—Taps, cocks, or valves.
1923. R. S. Harvey, Lincoln—Apparatus for dusting vines, hops and other plants and trees with sulphur, and other powder.

Dated 23rd August, 1859.

1925. P. F. C. de la Salle, Nice, Italy—Arranging the keys on the fingerboards of pianos, organs, and other similar instruments.
1927. T. Fry, Liverpool—The application of enamelled slate to the new purpose of lining, panelling, or otherwise facing the internal or external walls of houses.
1929. O. Maggs, Bourton, Dorset—Apparatus for weaving straw, rushes, and other materials into fabrics.

Dated 5th August, 1859.

1806. M. A. F. Mennons, 39, Rue de l'Exchiquier, Paris—Monuments to be employed as sentry boxes, branch post and other offices.

Dated 12th August, 1859.

1869. R. D. Clegg and T. Saunders, Islington—Locks.

Dated 23rd August, 1859.

1926. W. H. Hill, Birmingham—Manufacture of boxes or cases.
1928. W. Hollins and F. Hyde, Glossop, Derbyshire—Power looms for weaving.
1930. T. Richardson, New Bridge-street, Newcastle-on-Tyne Treating copper ores.

Dated 24th August, 1859.

1931. G. Pearson, Manchester—Boots and shoes.
1933. J. Henry, Bury, and J. E. H. Andrew, Audenshaw, Lancashire—Looms for weaving.
1934. J. Blake, Accrington, Lancashire—Steam and vacuum gauges.
1935. D. Russell, 1, Grove-cottage, Southampton-street, Camberwell, and J. Russell, 6, Devonshire, Queen's-road, Peckham—Means of docking and lifting ships out of the water, for the purpose of examining and effecting any necessary repairs.
1937. J. Murray, Dublin—Preparation and preserving carbonated cod liver oil.
1938. C. T. Judkins, 22, Ludgate-street, London—Sewing machines.
1965. D. Todd, Bridge-of-Weir, Renfrew, N.B.—Apparatus for carding and treating or preparing fibrous materials.

Dated 25th August, 1859.

1939. H. Smith and T. W. Ashley, Stamford—An improved construction of harrow.
1940. L. Perkins, Francis-street, Gray's-inn-road—Mills.
1941. A. P. Chamberlain, New Orleans, U.S.—Apparatus for cutting cork.

Dated 26th August, 1859.

1943. J. Furrell, 5, Upper Phillimore-place, Kensington—Lock protector.
1945. T. Bird, Manchester—Castors.
1946. J. M. Hetherington, Manchester—Apparatus for carding cotton and fibrous materials.
1947. H. Grundt, America-square—Life-boats.
1948. W. MacLellan, Glasgow—Rolling or shaping iron for railway spikes and other purposes.
1949. C. T. Boutet, 12, Chenies-street, Tottenham Court-road—A new mechanical mill proper for milling every sort of grains.

Dated 27th August, 1859.

1950. C. Hanson, Huddersfield—Chronometer escapement of a watch.
1951. F. Wrigley, Manchester—Construction of the permanent way of railways.
1952. J. R. Rostron, Edenfield, Lancashire—Manufacture of glass.
1954. T. Craven, Scarborough—Ball cocks or valves.
1955. G. Bell, South Inch Michael, Perth, N.B.—Reaping and mowing machines.
1956. J. Heckethorn, 32, Stanmore-street, Caledonian-road—Candles and wicks.
1958. E. Rettig, New-cross, Kent—Form and construction of anchors.

Dated 29th August, 1859.

1960. T. Meritou, 39, Pinnasberg, Saint Pauli, Hamburg—Governors for regulating the speed of marine engines.
1961. C. Kerman, Vulcan Iron Works, Millbrook, near Southampton—An apparatus to prevent the sinking of vessels through leakage.
1962. J. R. Howarth, Manchester—Apparatus for calendering and finishing textile fabrics.
1963. W. Clark, 53, Chancery-lane—Sewing and stitching by machinery.
1966. B. Baugh, Bradford-street, Birmingham—Machinery for raising or giving form to articles formed of sheet metal.
1967. G. S. Fleming, 498, New Oxford-street—A head-rest, suitable for keeping the head in a comfortable position in travelling.

Dated 30th August, 1859.

1969. J. B. Barnes, Summer-lane, and J. Loach, Caroline-street, Birmingham—Oars for impelling boats.
1971. J. Hare, Hamstead-road, Handsworth, near Birmingham—Pianofortes.
1975. C. Chambers and J. Chambers, Archer-street, Westhourne-grove, Middlesex—Apparatus for sawing staves and other forms of wood.
1977. R. F. Drury and E. Drury, Sheffield.

Dated 31st August, 1859.

1979. J. Nutall, Todmorden—Machinery used in preparing and spinning cotton.
1981. R. Beverley, Leeds—Wet gas meters.
1983. S. Middleton, Blackfriars-road—Improvement in the mode or method of uniting and otherwise manufacturing articles of leather, and such like materials, and in the apparatus and machinery connected therewith.
1985. A. Smith, Brentwood—Machinery for the preparation of cocoa-nut fibre.
1991. J. Chatterton, Devonshire-street, Islington—Manufacture of tubes of gutta percha.

Dated 1st September, 1859.

1993. J. A. Simpson, Liverpool—Hats and coverings for the head.
1995. T. Aveling, Rochester, Kent—Locomotive engines.
1997. R. H. Collyer, 8, Alpha-road, Regent's-park—Preparing materials for the manufacture of paper.

Dated 2nd September, 1859.

1999. J. Bernard, Albany, Piccadilly—Manufacture or production of boots and shoes.
2001. W. Brown, jun., and S. Bathgate, Selkirk, N.B.—Apparatus for grinding or sharpening the card teeth of carding engines for carding fibrous materials.
2003. W. Fearn, Leeds—An improved construction of buoy.
2005. S. D. Goff, H. Davis, S. Strangman, and E. Strangman, Waterford—Apparatus for drying malt, corn, and other articles.
2007. E. Button, Smith's-terrace, Chelsea—Apparatus for raising sunken vessels.

Dated 3rd September, 1859.

2011. J. Friou, 74, Newman-street, Oxford-street—Detaching instantly the locomotives from railway carriages.
2013. H. R. L. Schramm, Breslau, Prussia—Separating simultaneously the fibres and pellicles contained in the constituent matters of the beetroot, sugar, beer, beets, and other similar substances.
2015. W. Neilson, Glasgow—Steam hammers.
2017. J. C. Nixon, Nottingham—Kitchen ranges.
2019. C. Schiele, Oldham, Lancashire—Weighing machine.
2021. B. Lauth, Manchester—Manufacture of rollers or cylinders for calico printers.

Dated 5th September, 1859.

2023. W. Bush, Dulwich, Surrey—Manufacturing granulated seidlitz powder.
2025. J. W. P. Field, 233, High Holborn—Breech-loading fire-arms.
2027. V. Tomell, 294, King's Road, Chelsea—Manufacture of yeast.
2029. A. V. Newton, 66, Chancery-lane—Weighing machines.

Dated 6th September, 1859.

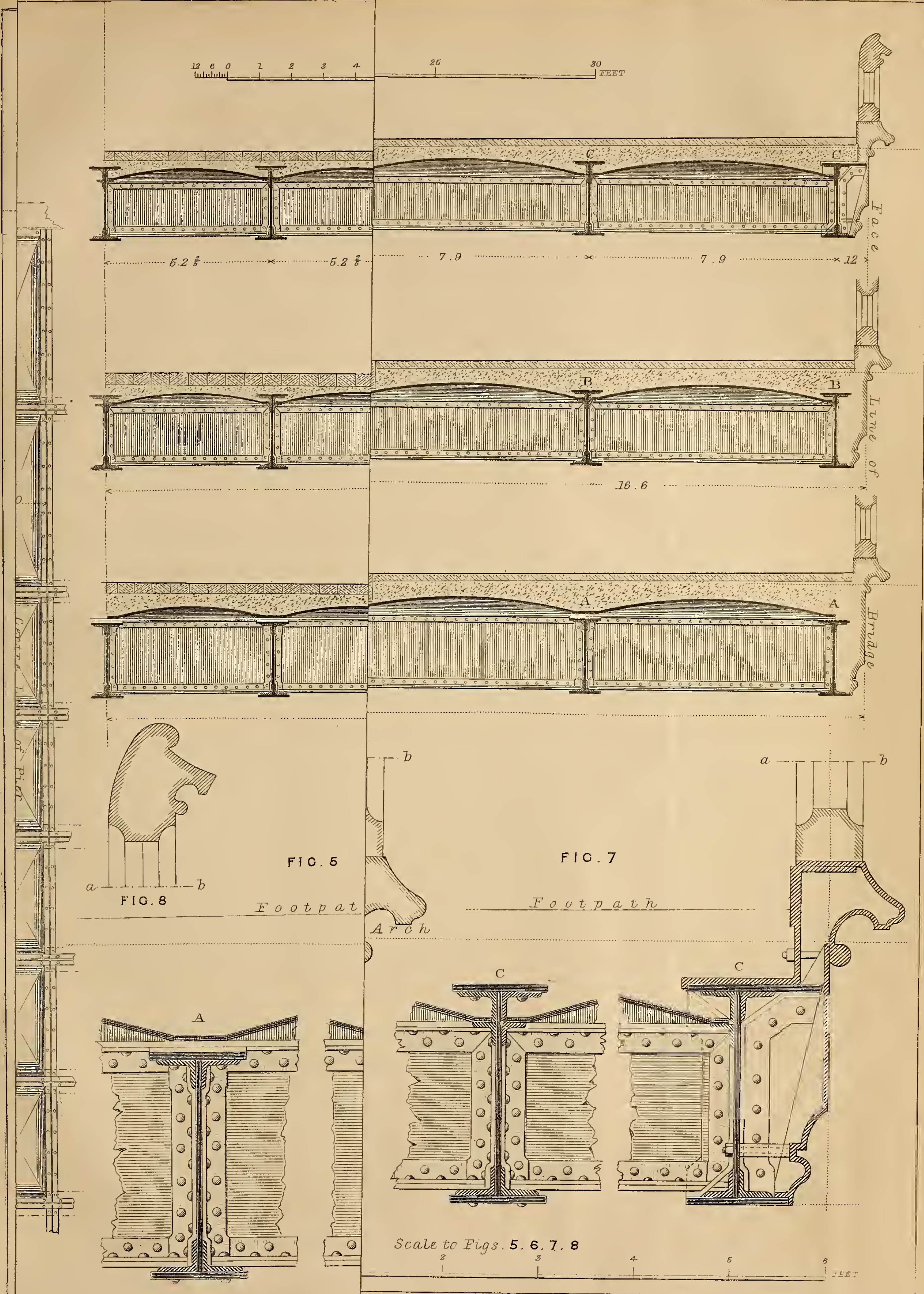
2031. R. K. Geldard, Plymouth—Apparatus for making pharmaceutical infusions.
2033. F. J. Manceaux, Paris—Cartridges.
2035. J. Stewart, 66, Tottenham Court-road—Pianoforte action.

Dated 7th September, 1859.

2037. J. J. Lyons, London—Manufacture of sugar.
2039. G. Lawrence, York-road, Battersea, Surrey—Construction of wheeled vehicles.
2041. W. J. J. Varillat, Rouen, France—An apparatus indicating the level of water in steam caldrons or boilers.
2043. J. P. Joule, Manchester—Apparatus for refrigerating and condensing steam or other vapours.
2045. A. V. Newton, 66, Chancery-lane—Manufacture of ladies' hooped skirts.
2947. E. T. Hughes, 123, Chancery-lane—Apparatus for forging metals.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1942. M. Billing, High Holborn.—An improved mode of ornamenting and finishing certain articles of hardware—26th August, 1859.
1944. M. J. Stark, Norwich—Producing a new chemical or artificial manure from bones, aad all such animal and fatty matters—26th August, 1859.
2032. J. J. Sieber, 5, Baring-street, New North-road—Power looms—6th September, 1869.
2072. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—An improved arrangement of piston packing, principally applicable to hydraulic apparatus. (A com.)—12th September, 1859.
2073. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Construction of hydraulic pumps. (A com.)—12th September, 1859.


12 6 0 1 2 3 4
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A
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Face
Line of
Bridge
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of Pier
FIG. 5
FIG. 7
FIG. 8
a
b
Footpat
Footpath
Arch
A
C
C
Scale to Figs. 5. 6. 7. 8
2
3
4
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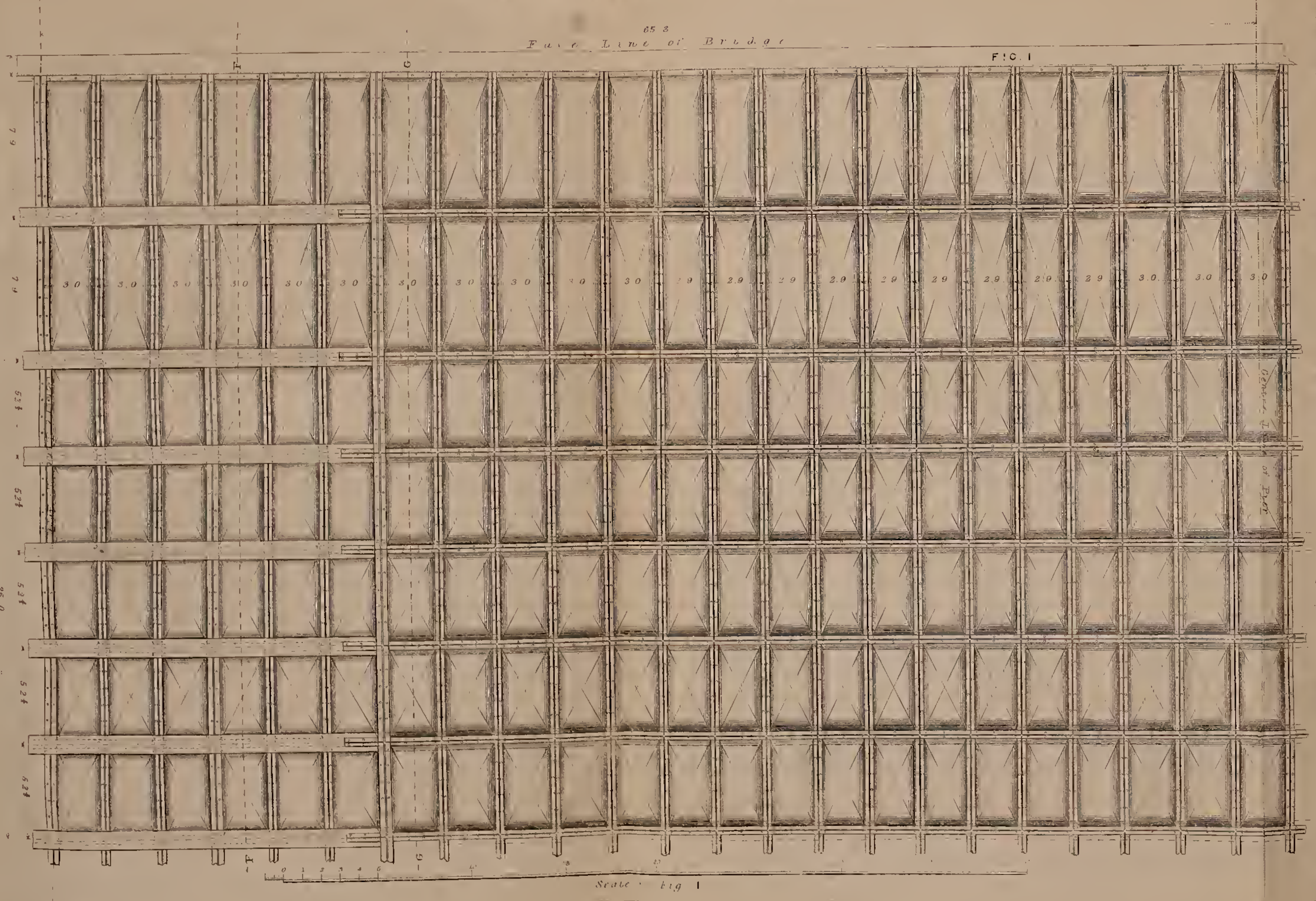
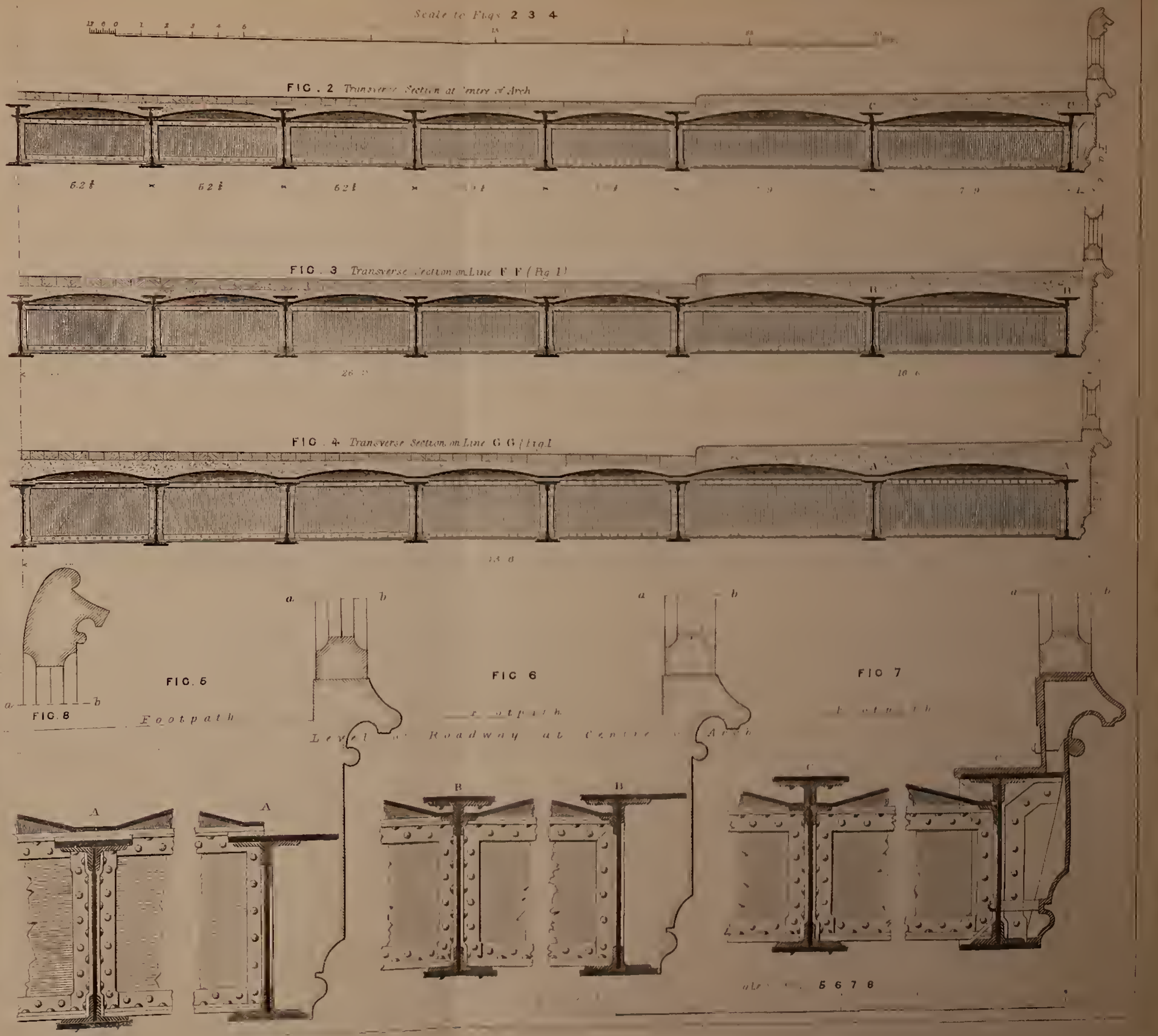
6
FEET

HALF PLAN OF SUPERSTRUCTURE & DETAILS OF

WESTMINSTER BRIDGE.





THE ARTIZAN.

No. 202.—Vol. 17.—NOVEMBER 1st., 1859.

NEW WESTMINSTER BRIDGE.

(ILLUSTRATED BY A LARGE COPPER-PLATE ENGRAVING, NO. 152.)

In our September number we gave the plate containing the details of the foundations and mode of construction in use in forming the piers, which had been previously described in our August number, and in the same number we continued our description of the general principles pursued in carrying out the works.

With the present number we give a plate of the superstructure and details, and continue our description of the bridge.

The solid granite exterior of the piers, and the internal brickwork being completed to the requisite height, the strong cast iron bed plates which carry the iron arches, are placed in their proper positions on the piers, and from them the arches spring to a distance nearly equal to one third of the span from each side, towards the centre, where they are joined by stout wrought iron crown pieces firmly rivetted to both sides, thus completing the arch; these will be more fully described and illustrated in the longitudinal section and elevation.

We may remark that the granite is of a very superior quality, the greater part being supplied from the Cornish quarries, and the remainder from the Haytor in Devonshire, and the workmanship of the whole is very fine, the joints being extremely close, and the stone well worked throughout.

On the cast iron work forming the arches, the buckled iron plates (Mallett's Patent) which carry the roadway are placed; these plates are seen in plan in Fig. 1, and in section in Figs. 2, 3, and 4; they are ¼in. thick, and have carried with the greatest ease a testing weight of eight tons each without any perceptible effect being produced, and by their employment great strength with considerable lightness may be obtained in all cases where such conditions require to be fulfilled.

These plates being firmly bolted to the iron work, are painted over with a preparation of bitumen, so that no air or moisture can come into contact with them, and the hollows, caused by the form of the plates, are carefully levelled to a nearly uniform surface, by blocks of well-seasoned heart of oak, placed with the end grain upwards, and carefully embedded in, and covered with bitumen (Trinidad), which is poured over and amongst them in a liquid state, the bitumen being melted in large boilers mounted on wheels over a small portable furnace, which are moved about as the work progresses, and thus a solid, waterproof, elastic, bed is formed throughout the whole length and breadth of the bridge, on which the filling for the metalling, or pitching of the roadway and pavement will rest.

There can be no doubt of the superior advantage gained by the employment of these plates, in place of the 4in. oak plankings, as intended originally for the flooring of the roadway, especially as there would have been some difficulty in obtaining such wood of the required size and quality sufficiently rapidly to have escaped the delays which would have arisen in that case and would have seriously retarded the progress of the work.

The breadth of the bridge is obtained by the use of 15 iron ribs or girders, one in the middle, and seven on each side, as shewn in Fig. 1, which is a plan of one half of the roadway of the bridge, taken on the top of the buckled plates; these ribs or girders are 5ft. 2⅜in. apart in the carriage way, and 7ft. 9in. in the footway, the distances being apportioned according to the proportionate weights to be carried on each part.

The bridge is intended to be furnished with two tramways for the going traffic, and two tramways for the coming traffic, each of which will be seven feet wide, the footways will each be 15 feet wide, and the remainder of the bridge will consist of an ordinary paved or metalled roadway for the ordinary traffic.

Looking at the immense amount of traffic over the old bridge, which is found to be most inconveniently narrow, we consider the width of the new bridge to be a most important advantage, standing as it does in the direct line of omnibuses and other traffic from the West End, and above all being a free bridge, while for the transit of goods, &c., going westward from the railways at Bricklayers' Arms and other places in the neighbourhood, it will, by its increased facility for crossing without the present stoppages, tend in no small degree to free London Bridge from its present constantly crowded, and frequently impassable condition.

As we have now concluded our description of the foundations of this bridge, it may not be out of place to enumerate a few of the examples in bridge-building, where the use of the cofferdam has been entirely dispensed with. The first of these is the Saumur Bridge, over the Loire, commenced in 1756 and completed in 1770. It has 12 arches of 66ft. span, and is 1060ft. long. The arches and piers are of stone. The foundations for the piers were formed by driving piles distributed over the whole area, which piles were cut off by a machine below low water, the space between the piles was filled in with stones, and the whole pier was encased by a row of close piling, which was protected from the scour of the river by fascines and stones, kept in place by an external row of piles. The piers, built in watertight caissons, are sunk on the spot on the heads of the piles. This bridge is still standing, and has been subject to all those extraordinary floods of the Loire, which have caused such ruin in the country through which the river flows.

The Nevers Viaduct over the same river was built in 1850 under the direction of a Commission of Engineers, composed of MM. Boucammont and others—it has seven arches 138 feet span, and is 1250 feet long. The arches are of iron, the piers of stone founded on a bed of concrete reaching nearly up to the low water line, and encased by sheet piling. The whole pier is protected outside from the scour of the river by means of concrete or rough stones.

The Alma Bridge at Paris, over the Seine, was built in 1855 by M. Michal under the direction of the Engineer-in-Chief of the Ponts et Chaussées, and completed in five months. It has three arches 141 feet span, and is 470 feet long. The arches and piers are built of rubble grouted; the piers are founded on piles driven into and standing above the bed of the river, and distributed over the whole area. The space between the piles is filled in with concrete and rough stones, the whole is enclosed by wooden sheet piling, and protected from the scour of the river by rough stones.

The Bridge of Ladenburgh, over the Nechar has seven arches of 88 feet span, built of stone founded on piles as before, encased by sheet piling and protected from the scour outside by rough stones.

The Bridge of Geneva over the Rhone, has five arches on one side of 51 feet span, and is a suspension truss bridge, piers founded on piles, driven and cut off above the bed of the river, and below low water. The space between the piles is filled with concrete, and encased by sheet piling protected by large stones. The Pont de Peney is a suspension bridge of 240 feet span, and the piers are founded on concrete above the bed of the river, encased by sheet piling, and protected from the scour of the river by large stones.

The Bridge of Souillac in the south of France has its piers of stone founded on piles distributed over the whole area. The piles are cut off below the low water level, and stand above the bed of the river, a height about equal to the breadth of the pier. The space between the piles is filled with concrete, deposited through the water by means of shoots. The foundations are encased by sheet pilings as before, with two extra rows of piling outside, the spaces being filled with concrete, and the whole of the foundations are protected from the scour of the river by means of loose stones. The water is very deep at low water.

In the bridge at Rouen over the Seine, the piers are of stone, founded on concrete, encased by sheet piling, and protected from the scour of the river by loose stones. The level of the concrete is considerably above the bed of the river. The piers were subjected to very severe tests before being finished.

The bridge at Westervoort over the Yssel, has its piers above low water constructed of an outside iron casing backed with a wall of brickwork three feet thick. The internal space is filled with concrete, and the piers below low water consist of iron plates sunk into the ground, the earth being there excavated, and the whole filled up with concrete.

At Marienburgh there is a tubular bridge over a branch of the Vistula, which has two spans of 380 feet. It is founded on stone piers which rest on foundations of piles, cut off below low water. The piers are encased by sheet piling coming up to low water, and the piers between the heads of the piles and low water are filled up with concrete. The piers are protected externally by rough stones. The river was deepened, and the slopes also protected by loose stones.

At Dorschau there is a bridge over the Vistula, built by M. Lenge, the Engineer, which has six spans of 397 feet, and its foundations are exactly similar to that just described.

The bridges over the Seine at Paris, of Austerlitz and Jena, have stone piers founded on piles driven into the bed of the river and cut off between the bed of the river and low water, and encased by sheet piling, and protected externally by stones, and an internal row of piles.

Over the Warthe at Wronke, is a bridge of six arches of 60 feet span, built in 1845, of stone and brick. The piers are founded on piles cut off between the bed of the river and low water, the space between the piles being filled with concrete. The whole piers are encased by sheet piling coming up to low water line, and the piers above the piles and below low water are filled in with rubble. The piers externally are protected by loese stones.

The Bridge of the Carrousel, over the Seine at Paris, has stone piers founded below water, entirely on concrete, resting on the bed of the river, and enclosed by wooden sheet piling, coming up to low water line, and tied across the top by means of iron ties. The depth of water at low water is 11ft. The pier is protected by loose stones thrown in round the timber sheet piling.

The Lary bridge, over a stream of that name near Plymouth, built by the late J. M. Rendel, Esq.,C.E. has five iron arches of 100 feet span, resting on stone pillars. The piers are founded on rows of piles driven into the bed of the river, and cut off below low water, by means of divers and diving bells. The piers are encased by sheet piling, and the space between the pile heads filled in with stone. The picrs were then built in caissons on top of this foundation and the bed of the river was protected from the scour by means of clay and concrete.

Old London Bridge of twenty arches, commenced in 1176 and finished in 1209, was of very massive construction, and had several very heavy buildings on it. It was taken down in 1834, after having stood 625 years.

The piers and arches of this bridge were of stone, and the foundations consisted of three rows of piles driven around the external face of the pier, and cut off at low water: the area of the piers up to low water was then filled in with stones, and the piers were then built upon the tops of the piles and stones; a further protection was then given to the piers by an external row of piles enclosing an area which was filled in with rough stones.

In our plate—fig. 1, is a plan of one half of an arch of the new bridge, taken from the centre line of pier to the centre of arch. It must be borne in mind that the breadth of the half shown, is only equal to half that of the new bridge.

This plan shows the arrangement of the buckled plates, which are bolted to the ribs and to small wrought iron cross bearers, also rivetted to the ribs, so that the plates are supported on their flanges all round.

Fig. 2 is a transverse section at centre of arch, showing the wrought iron ribs and the filling on the plates under the pitching (shown by the dotted space underneath the pitching).

Fig. 3 is a transverse section on the line F F, fig. 1.

Fig. 4 is a transverse section on the line G G, fig 1.

Figs. 5, 6, 7, are enlarged cross sections of the girders and plates at A A, B B, and C C, figs 2, 3, and 4, showing the details of construction.

Fig. 8 is an enlarged section of the ornamented coping on the balustrade of the footpath, on the line A B, figs. 5, 6, and 7.

SCREW PROPELLER EXPERIMENTS.

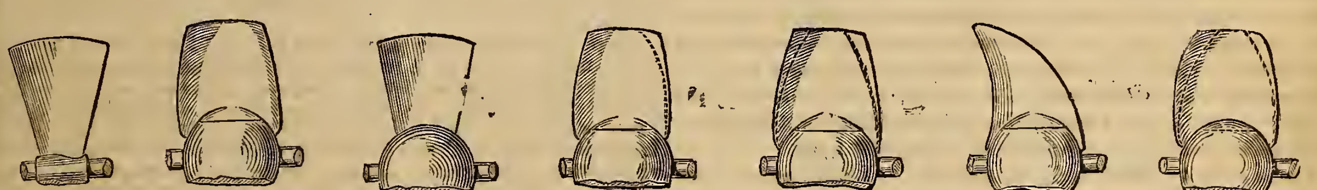
Since the days of Rattler experiments no series of practically useful experiments with different forms and dimensions of screw propellers have been undertaken by the Admiralty; true, the *Fairy, Shannon, Diadem, Doris,* and *Mersey,* have each been fitted with various screw propellers, which have been tried and "chopped and changed about," and some of the results of such trials have leaked out or found their way into public prints in an incomplete and almost totally useless form; for, many of the points and elements of calculation requsite for enabling exact results to be arrived at, have not been furnished; this is, doubtless, much to be regretted; but what is most required, is an uniform, more exact and extended system of conducting such experiments.

The experiments which were made with the screw propeller on board H. M. yacht *Fairy* in the years 1853 and 1855 have never yet been published, or supplied by the Admiralty to engineers and others interested in screw propulsion, in such a detailed form as to be practically useful. True it is that the Admiralty did, in May, 1850, and again in August, 1856, print the results of certain experiments made with screw ships in H.M. service, but it was not until after repeated applications for permission to publish those results in the Artizan, and up to the time when we had already set up in type the whole of those tables ready for publication in this Journal, that the restriction upon the publication of these experiments was withdrawn, and we gave to our readers with the number of the Artizan for 1st of March last, the mass of information which had been so long a time strictly withheld from the public, by the Admiralty; and although the tables were large and to some extent useful, yet they are very incomplete, and therefore not of as great practical value as they might, and really should have been.

The following details of experiments with screws of different powers tried on board the *Fairy* will doubtless prove of interest to our marine engineering friends:

HER MAJESTY'S YACHT "FAIRY."

Date of Trial.	Draught of Water.		Description of Screws.						Revolutions of Screw pr Minute.	Speed of		Slip of		Revolutions of Engines.	Ind. H.P.	Force of Wind
	For.	Aft.			Diam.	Pitch.	Length.	Area.		Screw pr hour.	Vessel pr hour.	Screw pr Hour.	Vessel pr cent.			
	Ft. In.	Ft. In.			Ft. In.	Ft. In.	Ft. In.	Sq. Ft.		Knots.	Knots.	Knots.	Knots.			
5th Feb.. 1853	5 0	7 0	No. 1	Smith's 2-bladed	6 6	7 $10\frac{3}{4}$	1 0	11·3	$192\frac{1}{2}$	14·99	12·09	2·90	19·33	$38\frac{1}{2}$	345	not noted
8th Feb., „	„	„	No. 2	Griffiths' 3-bladed	5 10	8 0 6 0 10 0 7 0 8 0	1 $7\frac{1}{2}$	9.4	$197\frac{1}{2}$ 180 1556 221 185	15·59 15·98 15·41 15·28 15·51	12·35 12·12 12·49 12·55 12·04	3.23 3.67 3.91 2.72 3.47	20·73 22·97 25·42 17·82 22·39	$39\frac{1}{2}$ 36 $31\frac{1}{4}$ $44\frac{1}{4}$ 37	359 337 287 403 340	„
19th Feb., „	„	„	No. 3	No. 1, with wood sphere	6 6	7 $10\frac{3}{4}$	1 0	11.3	$202\frac{1}{2}$	15·77	12·27	3.50	22·28	$40\frac{1}{2}$	363	„
24th March, „	„	„	No. 4	Griffiths' 2-bladed, cut from leading edge	6 6	9 0 8 0 7 6 9 6 10 0 12 0 8 6	1 7	6.92	$188\frac{3}{4}$ 207 218 177 176 145 $197\frac{1}{2}$	16·76 16·38 15·20 16·64 17·37 17·17 16·56	12·50 12·72 12·86 12·41 12·36 11·67 12·58	4·25 3·62 2·33 4·22 5·01 5·56 3·98	25·38 22·15 15·38 25·38 28·86 32·40 24·06	$37\frac{3}{4}$ $41\frac{1}{2}$ $43\frac{3}{4}$ $35\frac{1}{2}$ $35\frac{1}{4}$ 29 $39\frac{1}{2}$	362 375 392 326 328 290 346	„
28th March, „	„	„	No. 5.	No. 4, 2-bladed, cut from fore and after edge	6 6	12 0 10 0 9 6 8 6 7 6	1 7	6.18	153 180 $188\frac{3}{4}$ $203\frac{3}{4}$ 217	18.21 17·76 17·69 17·09 16·09	11·61 12·02 12·08 12·29 12·22	6.64 5·73 5·61 4·79 3·86	36·25 32·29 31·73 28·03 24·02	$30\frac{3}{4}$ 36 $37\frac{3}{4}$ $40\frac{3}{4}$ $43\frac{1}{2}$	293 349 345 362 357	1 to 2
17th April, 1855.	5 1	7 1	No. 6.	No. 6, Lewsey's, fitted to Griffiths' boss	6 $3\frac{3}{4}$	8 0 „ 10 0 „	1 8 „ 1 $8\frac{1}{2}$ „	8.4	$223\frac{3}{4}$ „ $202\frac{1}{2}$ „	17·66 „ 19·98 „	13·13 13·38 13·24 13·19	4·52 4·27 6·73 6·79	25·62 24·19 33·71 33·98	$44\frac{3}{4}$ „ $40\frac{1}{2}$ „	402 416	1 to 2
27th April, 1855	5 $3\frac{1}{2}$	7 1	No. 7.	No. 4, further reduced from after edge	6 $5\frac{3}{4}$	8 6 7 6 8 0 8 6	1 7	6.9	195 240 $218\frac{3}{4}$ 200	16·35 17·76 17·17 16·77	12·97 13·38 13·21 13·17	3·57 4·38 3·96 3·60	21·8 24·6 23·1 21·4	39 48 $43\frac{1}{2}$ 40	386 454 442 403	2 to 3



No. 1. No. 2 No. 3. No. 4. No. 5. No. 6. No. 7.

THE PACIFIC MAIL COMPANY'S STEAM SHIP "BOGOTA."

The successful alterations effected by Messrs. Randolph, Elder, and Co., of Glasgow, in the "Calao," "Lima," and "Bogota" steam ships belonging to the Pacific Mail Steam Ship Company, have already been noticed by us on more than one occasion, and we published in the Artizan for last month a paper communicated by Mr. Elder to section G. at the last meeting of the British Association, held at Aberdeen. That paper describes the machinery of the three ships above named, and details the advantages found, on actual practice, to result from the introduction of the double cylinder engines, boilers and superheating arrangements fitted on board those vessels, which had previously been fitted with engines and machinery by a very eminent firm.

We perceive by a notice in the City article of the *Times* of the 18th of October, of the "Bogota," one of the vessels refitted by Messrs. Randolph, Elder, and Co., that the importance of the subject has been sufficient to secure for it space in the most valuable portion of the leading daily London paper, but we have discovered two or three errors in the published notice of the "Bogota's" performance, which, perhaps, unimportant in the columns of a daily newspaper, should not go unchallenged. The following is the paragraph as corrected by us:—

The comparative merits of double-cylindered engines and those of the ordinary construction havn been considered for some time to constitute a question which would have an influence greater than any other on the progress of ocean steam navigation, from its bearing on the consumption of fuel. The Liverpool Pacific Steam Navigation Company have been the most active in testing the point, and they seem at length to have attained an amount of experience to warrant highly sanguine anticipations from the new system. The mail steamship "Bogota," 1250 tons, first left Liverpool, with the ordinary side lever engines, for Madeira, *en route* for the Pacific, in April, 1852, and performed as under:—

To Madeira, 1852.

Date.	Tons Coal.	Revolutions.	Pressure.	Miles.
April 16	$23\frac{1}{2}$	14,575	16 lb.	140
„ 17	36	22,305	„	270
„ 18	34	21,920	„	246
„ 19	48	23,950	„	230
„ 20	45	25,100	„	252
„ 21	$48\frac{1}{2}$	23,660	„	209
„ 22	$39\frac{1}{2}$	13,100	„	70
	$274\frac{1}{2}$	144,610		1,417

Thus a distance of 1,417 nautical miles was performed in six days 30 minutes, on a consumption of $274\frac{1}{2}$ tons of coals, giving an average of $9\frac{3}{4}$ knots on a consumption of 38 cwt. per hour. This vessel was brought home and had a spar deck added, by which the tonnage was increased to 1656 tons. She was refitted with the double cylinder engines by Randolph, Elder & Co., of Glasgow, the patentees, and left again direct for St. Vincent in Sept. last, and, under great disadvantages as regards wind and weather, performed as under:—

To St. Vincent, 1859.

Date.	Tons Coal.	Revolutions.	Pressure.	Miles.
Sept. 11	12	6,454	22 lb	53
„ 12	21	26,780	„	237
„ 13	22	24,910	„	193
„ 14	22	26,006	„	259
„ 15	22	26,970	„	247
„ 16	22	38,950	„	259
„ 17	22	29,110	„	253
„ 18	23	29,260	„	260
„ 19	24	29,960	„	263
„ 20	24	29,610	„	270
„ 21	18	19,550	„	176
	232	287,260		2,470

A distance of 2470 nautical miles in nine days 21 hours on a consumption of 232 tons of coal, and giving an average speed of 10·42 knots on a consumption of 19 cwt. per hour.

The average indicated horse-power being 950, gives an average $2\frac{1}{4}$ lbs. of coal per horse-power.

It should, however, be understood that it is not to the introduction of double-cylinder engines alone that the economy attained in the performance of the *Bogota* is attributable, as every one acquainted with steam engine construction and working must be perfectly well aware, but it is to the construction of a good furnace and combustion space, and the application of the principle of superheating the steam after its generation, and before entering the main steam pipe, by which means is attained the advantage of early cut-off, and considerable expansion of the steam in the cylinders. Now this being explained, the performance of the *Bogota* may most justly be said to be of the most satisfactory character; for, seeing that the distance run on the 11th September, before noon, was between Liverpool and Point Linas, or 53 miles, by the log, and that the total distance steamed was 2470 nautical miles, with 232 tons of coal—including that used in raising steam and in moving about in port during nine days twenty-one hours, or 237 hours, with a speed of 10-42 knots per hour during the whole period: the ship, be it remembered, was deeply immersed, and the weather during the whole run was heavy and unfavourable to a ship so heavely laden. If, however, the 193 knots recorded in the log as run against a very violent head wind, amounting to a severe gale and a heavy rolling sea, be excluded from the calculation it will be seen the speed would thereby be brought up to an average 10-7 knots.

Now, we find by reference to the logs of the *Bogota*, as previously engined, that her average speed under the favourable conditions of Pacific voyaging, was not exceeding 9.75 knots, and the coal consumption not less than 38 cwt. per hour. If the performance, as recorded on the voyage out under such unfavourable circumstances of both wind and sea, when during the 193 nautical miles, she had a sponson and the cattle-house forward washed away, and laboured heavily from the extent to which she was immersed, gave a mean speed of 10·47 knots, with 19 cwt. of coal per hour, what would have been the actual coal consumption with the old engines and boilers to attain the same speed, or 10·47 knots? If we are not mistaken, and have not in vain invoked Atherton to our aid, the coal account would stand as 46·55 cwt. *Bogota*, as formerly, against 19 cwt. per hour for *Bogota* as now fitted, and presuming we are correct in these results, the ratio of the one to the other, is that 40·081 per cent. does the same work as formerly; thus showing an economy of 59·919 per cent., or in round figures say 60 per cent., or $\frac{3}{5}$ of the former consumption; the coals in both cases being of exactly the same quality; but it must not be forgotten that the *displacement* of the ship was greater, and the weather most unfavourable to the *Bogota* as now fitted.

If the following method of calculating the coal consumption, which would have been necessary to propel the *Bogota* as formerly fitted, at the same speed, as the *Bogota* as now fitted is investigated, the mode of arriving at the above results will be readily understood.

Supposing these relations to be as the cubes of the velocities

thus, $9{\cdot}75^3 : 10{\cdot}47^3 :: 38$ (cwt. of coal) : required consumption.

$$\text{Then required consumption} = \frac{10{\cdot}47^3 \times 38}{9{\cdot}75^3} = \frac{1147{\cdot}7 \times 38}{936{\cdot}8} = \frac{436{\cdot}126}{936{\cdot}8} = 46{\cdot}55$$

the quantity of coal necessary to propel the *Bogota* with the former engines, boilers, &c., at 10·47 knots per hour.

We cannot too strongly impress upon those marine engine builders whose high reputation for good workmanship has obtained for them the almost entire business of the Admiralty, that something more than good workmanship is necessary in these times of economy; and unless they keep pace with the scientific progress and real advancements made by others in the generation and application of steam, for propelling ocean going steamships, and at once join the present onward movement, *the direction of which they should see*, they will have much lee-way to make up, and they should not forget that, "*a stern chase is a long chase.*"

GUN BOATS FOR THE SPANISH GOVERNMENT.

Messrs. Rennie and Sons have for some time past been engaged in building a considerable fleet of iron gun boats, of a novel construction, intended for use in the China Seas—it is said against pirates amongst the Phillipine Islands and colonial possessions of Spain. Instead of the ordinary construction of bulkhead, consisting of a single thickness of plate iron, a double bulkhead is formed by each section of each vessel having a bulkhead, converting it, as it were, into a pontoon, so that these are most conveniently brought face to face, and bolted together, by which a most secure and very strong construction is insured. Each vessel is propelled by two screws, one on each quarter, and by this means Messrs. Rennie have succeeded in obtaining a very satisfactory speed, and a facility for manœuvring rapidly is thus afforded which cannot by any possibility be attained in any vessel fitted with a single screw. The screws are two feet four inches in diameter, and five feet pitch; the screw shafts are slightly inclined upward at their inner end, and as the screws are capable of being rotated independently, the one forward and the other astern, the assistance in steering, and the facility offered for turning sharply within her own length must be of the greatest advantage to a gun boat, firing fore and aft. The following are some of the particulars of the Spanish gun boats now being sent out, viz., 8 of 75 feet by 12 feet and 20 h. p., with two single independent high-pressure engines, and two screws. These engines are of the same description and size as those sent out to India, and described in the Artizan of January, 1858, p. 10, but the boats are of greater size.

There are also six other boats, of 90 feet by 14 feet, and of 30 h. p. These engines are similar in construction and disposition, the diameter of cylinder being 12 inches; length of stroke, 13 inches; and giving 320 revolutions per minuts. The speed of the boats are about eight and a-half knots, or nine and a-half miles, when fully immersed; with 12 pounder iron guns of 23 cwts. These guns are placed forward, and are made to fire right ahead on the foremost fighting port (by the bulwarks falling down), within the angle of 70 degs. or 35 degs. on each side of line of keel; side fighting ports are arranged for firing broadside on, but as the boats are principally designed for chasing and destroying pirates at Manilla, the foremost port is considered the most effective while in action, as but a small surface of the vessel is exposed to the enemy's fire, whereas on broadside firing the whole length of the vessel serves as a target. As arrangement is made for sliding the gun down the hold of the vessel towards the centre of the boat, in order that the bows of the boat may be relieved in bad weather, and the top weight removed from the deck. The gun, when required in position, is raised from the hold by means of a windlass.

The draught of water of these boats was, at trial, two feet five inches aft, and one foot four inches forward, or a mean of one foot ten and a-half inches, with one and a-half day's coal on board, including gun, &c. With three days' coal on board, and the full complement of crew, provisions, and shot, her draught of water is two feet four inches on even keel.

Each vessel is fitted with two lateen sails and jib, and the masts are made so as to be lowered when in action.

At the present time, when the question of our coast defences occupies so large a share of public attention, Government would do well to follow the example set by Spain, and see that our coast line and the mouths of our rivers are well provided with such vessels, armed with the Armstrong, or other suitable rifled-guns of long range and heavy metal.

STEAM FIRE ENGINES.

The subject of Steam Fire Engines having created no little interest in England we present our readers with an account of some trials made in America, which we have abridged from the Philadelphia *Sunday Transcript*, Oct. 2nd:—

Since our last issue, has come off the contest for the palm of superiority between such of the steam fire engines as were exhibited at the Fair of the Agricultural Society, Philadelphia, Sept. 28th. The first struggle took place on Wednesday between the Good Intent, Weccacoe, and Southwark steam fire engines The result of the playing was as follows:—

Good Intent Steam Fire Engine.

Time in getting up steam, 14 min. 20 sec. Nozzle 1 inch in diameter.

Length of Hose 219 feet.	Pressure of Steam and in Air Chamber. Steam.	Air Chamber.
At starting	35 pounds.	0
In five minutes	63 do	110
In ten minutes	75 do	125
In fifteen minutes	77 do	130
In twenty minutes	90 do	142
Maximum pressure	95 do	

Horizontal stream, 169 feet, vertical stream, 140 feet.

Weccacoe Steam Fire Engine.

Time in getting up steam 15 minutes. Nozzle $1\frac{1}{4}$ inch.

Length of hose $208\frac{1}{2}$ feet.	Pressure of Steam and in Air Chamber. Steam.	Air Chamber.
At starting	50 pounds.	0
In five minutes	47 do	47
In ten minutes	40 do	60
In fifteen minutes	37 do	50
In twenty minutes	35 do	60
Maximum pressure	70 do	

Horizontal stream, 109 feet; vertical stream, 83 feet.

Southwark Steam Fire Engine

Nozzle $1\frac{1}{2}$ inch.

Length of hose 216 feet.	Steam.	Air Chamber.
At starting	176 pounds.	0
In five minutes	117 do.	75
In ten minutes	67 do.	40
In fifteen minutes	45 do.	35
In twenty minutes	56 do.	44
Maximum pressure	40 do.	

Horizontal stream, 145 feet. Did not throw vertically.

The distance the water was thrown vertically, was ascertained by a diagram of the mast, which was measured before putting up. The height of the whole was 173 feet from the ground. A line of small tin cups was also suspended from the top, and drawn down after each engine had played, to indicate how high the water was thrown.

Each engine played twenty minutes, the time being reckoned from the period at which steam was generated. The operations of the various engines were either superintended or overlooked by the respective builders, while the judges of the trial, Messrs. John C. Cresson, Peter Fritz, and A. M. Eastwick, made the measurements, tested the nozzle with inside callipers, kept the records of steam and air pressure, and made general observations of the working of each engine. The trial occupied the whole afternoon up to the time of the closing of the Fair, and was conducted with good feeling on the part of the participants.

The trial of steam engines, on Thursday, was commenced with Baltimore, No. 7, built by Poole and Hunt, Baltimore. Steam was raised in 11 minutes; length of hose used, 205 feet 7 inches; diameter of Nozzle, 1 inch. During the trial, the goose-neck to which the hose was attached, was blown out. A second trial was allowed, when with a steam pressure of from forty to one hundred pounds, she threw a horizontal stream 116 feet, and a vertical one 167 feet.

The Independence Steam Fire Engine, built by Hunsworth, Eakins & Co., of this city. Steam was raised in 15 min. 30 secs.; length of hose, 216 feet 6 inches; nozzle $1\frac{1}{4}$ inch. With a maximum steam pressure of 80 pounds, she threw a horizontal stream of 193 feet, vertical 143 feet.

The hand engines were next tried, being supplied with water from the Independence Steam Fire Engine. The engines were all fully manned, and played about two minutes each, with the following result:—Citizen, of Harrisburg, using 1 inch nozzle and 10 feet of hose, 196 feet horizontally. Assistance, of Philadelphia, same sized nozzle and hose, 182 feet $4\frac{1}{4}$ inches. This engine, according to the rules, was allowed 35 feet from the Citizen, on account of smaller chamber. Second class—Washington $\frac{7}{8}$ nozzle, 50 feet of hose, 154 feet horizontally; Philadelphia, 188 feet 3 inches; Weccacoe, 154 feet; Globe, 150 feet, and 5 feet allowance; Franklin, of Frankford, 158 feet, and 5 feet allowance.

We give the result in detail of the playing of the *Baltimore* steamer, as copied from the report of the judges:—

Time occupied from the lighting of the fire until the starting of the engines, 11 minutes.

Length of hose . . . . 205 feet 7 inches.
Diameter of Nozzle . . . . . . 1 inch.

	Pressure of steam and on air chamber. Steam	Air vessel
At starting	50 pounds.	0 pounds.
In five minutes	60 do.	32 do.
In ten minutes	100 do.	180 do.

Horizontal stream . . . . 130 feet 9 inches.
No vertical stream.

The time fixed for the display of each engine was twenty minutes, but owing to the sudden detachment of the "goose-neck" of the Baltimore, she was unable to play longer than ten minutes on her first trial. This defect was soon remedied, and a second trial of her powers was given, when she played for twenty minutes with the following result:—

	Steam.	Air vessel.
At commencement of observation	100 pounds.	70 pounds.
In five minutes	72 do.	150 do.
In ten minutes	81 do.	100 do.
In fifteen minutes	90 do.	170 do.
In twenty minutes	45 do.	80 do.

Horizontal stream, 196 feet; vertical stream, 166 feet.

The *Independence* steamer, manufactured in Philadelphia, was next tested Time occupied from the lighting of the fire until the starting of the engine, 15 minutes 30 seconds.

Length of hose . . . . 216 feet 7 inches.
Diameter of nozzle . . . . . . $1\frac{1}{4}$ inch.
Pressure of steam and on air vessel:

	Steam.	Air vessel.
At starting	60 pounds.	0 pounds.
In five minutes	80 do.	100 do.
In ten minutes	70 do.	120 do.
In fifteen minutes	70 do.	97 do.
In twenty minutes	77 do.	133 do.

Horizontal stream 193 feet; vertical stream 143 feet.

The final trial of steam engines took place at the Fair grounds on Friday afternoon, when the Hibernia, Washington, and Mechanic, contended for the premium. As will be seen by the report annexed, the Hibernia came off the victor.

Washington, made by Poole & Hunt, Baltimore. Time occupied from the lighting of the fire until she was started, 18 minutes 30 seconds.

Length of hose . . . . . 205 feet 10 inches.
Diameter of nozzle . . . . . . $1\frac{1}{4}$ inch.

	Steam.	Air vessel.
At starting	85 pounds.	0 pounds.
In five minutes	90 do.	125 do.
In ten minutes	80 do.	100 do.
In fifteen minutes	80 do.	120 do.
In twenty minutes	70 do.	140 do.
Maximum pressure of steam		95 do.
Horizontal stream		239 feet.
Vertical stream, estimated		178 do.

Water was found in all the cups on the flag staff.

Mechanic, made by Reaney & Neafie. Time occupied from the lighting of the fire until the engine was started, 13 minutes 20 seconds.

Length of hose . . . . 208 feet 10 inches.
Diameter of nozzle . . . . . . 1 inch.
Pressure of steam and on air vessel:—

	Steam.	Air vessel.
At starting	55 pounds.	0 pounds.
In five minutes	92 do.	60 do.
In ten minutes	105 do.	32 do.
In fifteen minutes	92 do.	180 do.
In twenty minutes	80 do.	160 do.
Maximum pressure of steam		115 do.
Horizontal stream		203 feet.
Vertical stream		167 do.

Water in all the cups but the uppermost.

In a short time after the engine was started the hose burst. The engine was, however, kept in motion, and in a short time another hose was attached, which also burst. This having been repaired, the engine continued for the remainder of the twenty minutes allowed to each engine.

Hibernia, made by Reaney, Neafie & Co. Time occupied from lighting the fire until the engine was started, 12 minutes 21 seconds.

Length of hose . . . . 203 feet 6 inches.
Diameter of nozzle . . . . . $1\frac{5}{16}$ inches.
Pressure of steam and on air vessel:

	Steam.	Air vessel.
At starting	60 pounds.	0 pounds.
In five minutes	105 do.	190 do.
In ten minutes	65 do.	135 do.
In fifteen minutes	90 do.	75 do.
In twenty minutes	95 do.	120 do.
Horizontal stream		254 feet.
Vertical stream, estimated		181 do.

The steamers Washington and Hibernia threw their vertical streams over the top of the flag-staff, the former about five feet, and the latter about fifteen feet.

During the forenoon the Citizen was tried in front of the Good Will Engine house. Through a $1\frac{1}{8}$ inch nozzle water was thrown, horizontally, a distance of 210 feet.

The Hibernia steam fire engine has since had alterations to her flues, substituting iron instead of copper.

The following are some particulars of the engines tried:—"Southwark," self-propelling engine, rotary pump, built by Lee and Larner, New York—2 steam cylinders, $7\frac{1}{2}$in. diameter, 14in. stroke; 1 rotary pump, 17in. diameter, 10in. wide; weight, 9,000lbs; cost, $6,250. The performance of this engine was very small. On the previous day she was tried on J. P. Morris and Co.'s wharf. On account of the direction of the wind it was necessary to throw the stream overboard, and there was, therefore, some difficulty in measuring the distance. The members of the Fire Company claimed that she threw 240ft. through a $1\frac{1}{2}$in-nozzle; it would therefore appear that when in good order this pump will throw a very effective stream, but like most of the rotary pumps it soon gets out of order.

"Good Intent," built by Reaney and Neafie, Philada—steam cylinder, 8in. by 12in stroke; pump. $4\frac{5}{8}$in. by 12in. stroke; weight, 5,400lbs; cost, $3,150. This engine, which, for its weight, appears to be the most efficient of all those tried, is similar in arrangement to the "West Philadelphia."

"Weccacoe," built by Merrick and Sons, Philadelphia—steam cylinder, $8\frac{1}{2}$in. by 14in. stroke; pump, 6in. by 16in. stroke; cost, $3,500.

No. 7 Baltimore," built by Poole and Hunt, Baltimore—steam cylinder, 14in. by 12in. stroke; pump, $4\frac{1}{2}$in. by 12in. stroke; weight, 5,456lbs.; cost, $3,000.

"Independence," built at People's Works, Philadelphia—steam cylinder, 10½in. by 14in. stroke; pump, 5½in by 14in. stroke; cost $3,800. Arraugemeut similar to the "West Philadelpbia."

"Washington," built by Poole and Hunt, Baltimore—steam cyliuder, 12½in. by 12in. stroke; pump, 6⅝in. by 12in. stroke; weight, 3,582lbs.; cost, $3,300.

"Mechanic," built by Reaney and Neafie, Philadelphia—steam cylinder, 8in. by 16in. stroke; pump, 4⅝in. by 16in. stroke; weight, 5.760lbs.; cost, $3,300. Arrauged like the "West Philadelphia."

"Hibernia," built by Reaney and Neafie, Philadelphia—steam cylinder, 11¼in. by 14in. stroke; pump, 6½in. by 14in. stroke; weight, 8,000lbs.; cost, $4,325. Arranged like the "West Philadelphia."

In all cases the weight given includes, we believe, the water in the boiler. So far, the majority of these engines have cost a great deal for repairs; and in one case the repairs in the first year amounted to oue-third of the original cost of the machine.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

ABERDEEN MEETING, SEPT. 14TH TO 21ST, 1859.

PAPERS READ IN SECTION G.

MEMORANDUM FOR THE BRITISH ASSOCIATION, AT ITS MEETING TO BE HELD AT ABERDEEN IN SEPTEMBER, 1859.

BY VICE-ADMIRAL MOORSOM.

At the last meeting of the Association at Leeds, a Paper "On the Performance of Steam Vessels" was read, in which some account was given of the *Erminia*, a yacht belonging to Lord Dufferin, and I have now to present some particulars of her performance.

A return has been handed by Mr. M'Connell to the "Steam Ship Performance Committee," of certain trials of the *Erminia* in Stokes Bay, on the 12th October last; and the following further particulars of that vessel and her engines will enable the members of the Association to follow me in the description I am now about to give, and to check any errors into which I may have fallen:—

Length of Water-line	92·20	feet.
Breadth, extreme	22·66	„
Draught of Water { F.	9·50	„
Draught of Water { A.	19·90	„
Displacement, about	244	tons.
Area of greatest Transverse Section	149·18	sq. feet.
Diameter of Screw	8	feet.
Pitch of ditto	13	„
Length	1·34	„
Extreme breadth of each Blade	3·00	„
Area of Blade, about	15·5	sq. feet.
Immersiou of Periphery	2·5	feet.
Diameter of Cylinder	15	inches.
Length of Stroke	18	„
Area of Fire-Grate	14·124	sq. feet.
„ Fire-Box	92.96	„
„ Tubes	446.22	„
„ Steam Ports	12 × 1¼	inches.
Diameter of Blast Pipes	4	„

The performance at the measured mile, being the mean of four trips, was as follows:—

Speed of Vessel—knots	6
„ Screw	6·72
Slip per cent.	10·66
Revolutions per minute	52·37
Indicator Horse-power by 8 diagrams	54.59
Mean Pressure in Boiler	51·80 lbs.
„ in Cylinder	32·07 „

I had written to Lord Dufferin in August, that I anticipated a speed of 6 knots from 90 horse-power, and that I had selected a *coarser* pitch than I should otherwise have preferred, iu consequence of some difficulty iu estimating the thrust, and that the slip might be about 21 per ceut. The results show a much better performance, and I must now explain the data on which my calculations were based.

The resistance of the vessel at 6 knots in smooth water was first estimated by resolving the resisting surfaces into an equivalent plane surface, and deducting the specific resistance of form by an empirical application of the method of Dou Gorges Juan. This gave 2763·5 lbs. It was, secondly, estimated by another empirical process, which I had found to answer within given limits of form, and was founded on Beaufoy's experiments. This gave a specific resistauce of 1,896 lbs. In the absence of experiments that can be depended on for determining the thrust of the screw, I considered it safest to adopt the larger resistance, aud to take as large a diameter for the screw as would admit of its being effectually immersed, so that the thrust should not be broken, and 8 feet was selected. Now, the pitch of a screw of 8 feet diameter, to produce a *resultant* thrust of 2763·5 lbs. at 6 knots, is 13·37 feet. The pitch selected being 13 feet, the slip to balance should be 21·11 per cent. Then, how comes the actual slip to be only 10·66 per cent.? The answer to this is the key to the whole operation, and it is this:—The *direct* thrust of the screw under the actual circumstances of the trial was 2122·7 lbs., and the *resultant* was 1896·4 lbs., and the difference of the ratios of their square roots is 10·66. But 1896 lbs. is also the specific resistance as estimated by the second method, and as the thrust calculated by au independent process comes out the same, within half a pound, the concurreuce of the two seems to establish *that* as the actual resistance at the time of the trial. Such concurreuce may not, however, be held to be conclusive. Figures are said to have a singular facility in producing pleasant results. There are two modes by which these results may be tested, the one analytical, the other synthetical. I will begin with the first, and employ the other in elucidation. The effective power, or total resistance, from the actual power of 54·49 horse-power, or 1,801,470 lbs. at 6 knots, is 2961·67 lbs., which is thus distributed:—

Specific resistance	1896 lbs.
Equivalent of slip	315·67 „
Resultant of absorbed power	750 „
Total	2961·67 lbs.

I have in this analysis, as in my former paper, classed under the general term "equivalent of slip," two distiuct elements, which I must now separate. The first is, that portion of the effective power which overcomes the resistance of the water to the rotation of the blades of the screw, and which is sometimes called "lateral slip." The second is, that portion of the effective power which is employed in pushing back the water to obtain a fulcrum.

The first is	204 lbs.
The second is	111·67 „
Making together the	315·67 lbs.

The absorbed power is composed of—1st, the friction of moving the machinery; 2nd, the additional friction of the load; 3rd, the back pressure (as we are dealing with a non-coudensing engine) from the blast-pipes.

For the first we have	136·92 lbs.
„ second	189·60 „
„ third	423·48 „
Makiug the total of	750 lbs.

In order to give a clearer view of these elements I will reverse them and show the corresponding pressure ou the pistou.

	lbs.	Pressure on Piston. lbs. per square inch.
Back-pressure	423·48	4·64
Additional friction of load	189·60	2·07
Moving friction	136·92	1·50
Resistance of water to rotation of blades	204·00	2·23
Slip in terms of effective power	111·67	1·22
Specific resistance of vessel	1896·00	20·78
Making the totals of	2961·67 and	32·44

The pressure on the piston by the diagrams is 32·07 lbs., showing a difference of 0·37 which may be considered near enough.

Now, if it be said that this is an arbitrary classification not restiug upon known data, I reply, not altogether so. I have, lying before me, diagrams of back-pressure from 3·45 lbs. per square inch ou the piston, moving at 236 feeet per minute, with a mean pressure of 67·56 lbs. to 12·3 lbs. per square inch on the piston, moving at 569 feet per minute, with a mean pressure of 65 lbs., the diameters of blast-pipes varying from 4⅝ to 4¼ inches, and the relations of steam ports from 14 × 1⅞ inches to 12½ × 1½ inches of area.

The *Erminia's* blast-pipes were 4 inches in diameter, the steam ports 12 & 1¼, and the speed of piston 157 feet per minute, with a pressure of 32·07 lbs. per per square iuch in the cylinder.

The back pressure of 4·64 lbs., which results from the analysis is, therefore, probable, and consistent with experience.

The next elemeut of additional friction arising from the load, viz., 2·07 lbs. per square inch is calculated upou the specific resistance of 1896 lbs., and may be disputed, because there are no satisfactory experiments on the subject. It is an estimate, and may be in excess. The next element of the pressure to move the machinery, viz., 1·5 lb. per square inch, is a little over the mean of certain trials made by my direction, of which the diagrams are before me, the maximum being 1.63 lbs., and the minimum 1·14 lbs. To this no reasonable exception can be taken. The resistance to the rotation of the blades, 2·23 lbs., is calculated upon the basis of such experiments as I have access to on the friction of water ou iron, and on the effective periphery of the screw. For this element, also, more precise experiments are needed, and it must be considered au estimate only. The slip, 1·22 lbs., requires uo elucidation, except that it is what remains after deducting the effect of the resistauce to the rotation of the blades. The specific resistance, equal to 20·78 lbs. per square iuch on the piston, or in the convertible terms of 1896 lbs. of effective power, may, therefore, be dealt with as a probable result, and if so, the power of tbe screw is needlessly in excess of any resistance the *Erminia* is likely to offer, and I have explained why it is so, viz., because it was designed to produce a thrust at about 21 per cent. of slip, about 50 per cent. greater than the resistance of the vessel *in smooth water*, which resistance, viz., 2763·5 lbs., turns out to be 45 per cent. greater thau the actual resistance. Hence the screw is *capable* of a thrust nearly double of what the *Erminia* requires in smooth water.

What, then, is the most suitable size and proportion of screw for this yacht? I believe it will be found that the diameter should be as large as is consistent with its being *sufficiently* immersed, but uo larger, and that the pitch should then be such as to produce a thrust to balance the resistance under ordinary conditious at sea with a moderate slip. If the screw be 8 feet iu diameter, then, to produce a thrust of 1896 lbs. at 6 knots, the pitch must be 9·18 feet, and the slip about 13½ per cent. But, under ordinary conditions at sea, the resistance will be increased, and it is expedient to have a coarser pitch, in order that the thrust may balance the resistance without excessive slip. If we assume the specific resistance at a meau between the two calculated results before described, or 2329·75 lbs., the pitch must be 11·27 feet; and when the thrust works up to this resistance, the slip will be about 20 per cent.

I must now draw attention to other trials of the *Erminia*, viz.:—

First, on the 27th September:—

Speed of vessel	6·83 knots.
" screw	7·76
Slip per cent.	10·75
No. of revolutions	60·05
Mean pressure in cylinder	45 lbs.
Indicator horse-power	87.40
Diameter of screw	8 feet.
Pitch "	13 "

The results alone of this trial were sent to me, and not the particulars; and I have no means of checking them.

On comparing the speed with that obtained on the 12th October—viz., 6 knots, with 54·59 horse-power—it will be found to be less than it should be—viz., 6·83 knots, instead of 7.

Second, on the 28th September:—

Speed of vessel	7·98 knots.
" screw	10.39
Slip per cent.	23
No. of revolutions	81
Mean pressure in cylinder	46 lbs. per sq. in.
Indicator horse-power	121·9
Diameter of screw	7 feet.
Pitch "	13 "

In this case, also, I was only furnished with results. The speed comes out a little beyond what it should be compared with the conditions of 12th October, viz., 7·98, instead of 7·84 knots. It will be seen that the slip is more than double of that which took place on the two trials with the 8-foot screw, on the 27th September and 12th October, and more than two per cent. greater than that which I had estimated as due to the thrust to balance the resistance of 2763·5 lbs.

In a report to the Admiralty, by Admiral Ramsay, Mr. Nasmyth, and Mr. Ward, occurs the following passage:—

"All the evidence received shows that, where a ship has very fine lines, a coarse pitched screw, with comparatively small diameter, gives the greatest speed."

The language in which the proposition is couched and the condition by which it is guarded, prevent me, in the absence of the evidence on which it is founded, from saying more than that I must doubt the conclusion till I see facts in its support. It seems to be quite at variance with the principle on which the action of the screw rests, but here is an example to bear out the proposition. Having received some particulars of the *Erminia's* passage under steam from Malta to Alexandria, from the 7th to 9th of December, I may suitably introduce them here:—

Speed of vessel (mean average)	6·50 knots.
" screw	9·87 "
Slip per cent.	34·20
No. of revolutions	77
Pressure in boiler	60 lbs.
Coal used in 45·5 hours	8 tons.

These particulars are not sufficient to justify any deductions, and mere inferences might only mislead. There is no risk of being far wrong, however, in saying that the resistance in this passage must have increased in a greater ratio than the increase of speed would account for. The diameter of the screw, 7 feet, with the original pitch of 13 feet, accounts for the slip of 34·2 per cent.—on the supposition only of an increased ratio of resistance.

The next vessel to which I must invite attention is the yacht of the Duke of Sutherland, mentioned in my former paper.

Full particulars of the performance of the *Undine* at the measured mile in the Thames, on the 6th July, 1858, in Loch-Lochy on the 27th October, and in Loch-Ness on the preceding day, have been laid before the "Steam Ship Performance Committee" by Mr. M'Connell. The particulars of this vessel are:—

Length of Water-line		125 feet.
Breadth, extreme		25 "
Draught of Water	F.	8·6 inch.
	A.	11·10 "
Displacement about		294 tons.
Area of greatest Transverse Section.		154·33 sq. feet.
Diameter of Screw		7·10 inch.
Pitch, &c.		11·4 "
Length		1·4 "
Extreme breadth of Blade		2·8 "
Area of Blade, about		13 sq. feet.
Immersion of Periphery		1·8 inch.
Diameter of Cylinder		0·24 "
Stroke		0·15 "
Area of Fire-Grate		45 sq. feet.
Plate surface		206 "
Tubes		820 "

The performance on the 6th July was:—

Speed of Vessel	9·26 knots.
Screw	11·29
Slip per cent.	17·91
Revolutions per minute	101·74
Indicator Horse-power by diagrams	157·09
	lbs. per sq. in.
Mean Pressure in Cylinder	12·28
" from Vacuum	10·70
Total Pressure	22·98
Mean Pressure in Boiler	15·80

Now, the specific resistance of the *Undine* at 9·26 knots, estimated as the *Erminia's*, by the empirical rule founded on Beaufoy's experiments, is 3809·4 lbs. By the synthetical method it is as under, viz.:—

	Lbs. per square inch.	Lbs. in terms of Effective power.
Moving Friction	1·40	342·89
Additional Friction for Load	1·55	380·94
Resistance to Rotation of Blades	2·37	582·50
Slip in terms of Effective Power	1·65	405·10
Total less Specific Resistance	6·97	1711·43
Total Pressure and Effective Power	22·51	5517
Specific Resistance	15·54	3805·57

The difference between 3805·57 and 3809·4 is not material in estimates such as this. It will be seen, also, that there is a difference of 0·47 lbs. per square inch in the aggregate pressure as compared with that given by the diagrams. So far the two methods are in harmony; but now I have to show a screw that is not so tractable. The *direct* thrust at 11·29 knots, is 7469·3 lbs., and the slip being 17·91 per cent., the *resultant* is 5022·3 lbs., or more than 31 per cent. greater than the resistance of the vessel. This, however, cannot be so, and the apparent excess must be accounted for. I have already said that the screw must be *sufficiently* immersed, in order that its thrust may be that which is due to its diameter and pitch. What is *sufficient* is yet an open question. The *Erminia's* was 2 feet 6 inches, the *Undine's* only 1 foot 8 inches. I believe this to be the explanation of the anomaly. The apparent thrust of 5022·3 lbs. was really an effective thrust of only 3805·57 lbs. in consequence of the rotation of the blade breaking up the surface of the water. This screw would produce, if sufficiently immersed, a resultant thrust of 3805·57 lbs. at 9·26 knots, with a slip of 10·32, say $10\frac{1}{2}$ per cent. The actual slip was 17·91 per cent.

I have found the same results in several ships of war. In all whose screws are near the surface. In none whose screws are buried.

We have now reached one of the most interesting of the investigations, which, in my former memoranda, I pointed out as worthy of the attention of the British Association. This is an investigation by experiment not difficult to accomplish, and yet I conclude it has not had the consideration of the naval authorities, as they continue to give screws to their ships, which are only immersed about one-fourth to one-eighth of their diameter, whereas the *Erminia's* was immersed about one-third, whilst the *Undine's* was about one-fifth. The due proportion of immersion will, I believe, be found to depend somewhat on the speed of rotation. I wish to guard myself against being misunderstood as to these estimates. They are rough approximations thrown out for the purpose of bringing to a practical issue the application of certain known laws of fluids. The application here is, as I have repeatedly declared, *purely empirical.* It is the result of the observation and experience of one who has no theory to advance or to support, but who, as a sea officer, and as having also been actively engaged in the construction of some of the greatest public works of this country, and as being now occupied in the management of one of its largest commercial undertakings—has been in the habit of recording and classifying facts with a view to the induction of laws, and to bring within the sphere of scientific calculation what is generally determined by the sort of experience, popularly called the "rule of thumb." He knows by experience that accuracy may be ensured, and time and money saved by estimates, however rough, if based on certain ascertained facts as against opinions the most experienced; and he believes that the laws which govern the resistance of ships under various conditions, may be ascertained sufficiently to guard against the mistakes of which every one concerned in shipping is aware.

There are two packets plying between Holyhead and Kingstown which have made that passage at the rate of nearly 19 statute miles an hour, and their displacement is only about 600 tons. When, in 1846, those vessels were designed, though I had no responsibility in designing them, I told my colleagues that their speed might reach 20 statute miles an hour. This was not a *guess*, it was an *estimate.* It turned out, however, that the requisite length could not be given to them. One of these vessels is capable of making way against any head-sea and wind short of a hurricane. In running before the wind she is uneasy, and requires nice management. The other cannot encounter a heavy head-sea like the first, but she "scuds" with ease and comfort. A seaman will give a reason for this difference, and probably he might be right; but I doubt if he could show how a vessel is to be designed so as to unite the two best qualities of each. Yet their union is practicable; and in the records from which are compiled the returns presented to the "Steam Ship Performance Committee" are the facts which would enable a scientific naval architect to effect that union.

A question may here be asked which I am not in a condition to answer. Has the speed of ships increased in the ratio due to their increase of size?

Does the speed of the Mersey of 5462 tons, being about $13\frac{1}{4}$ knots, with 4044 horse-power, answer to the deductions of science when compared with the Rattler of 1078 tons, with a speed of about $9\frac{1}{2}$ knots, with 436·7 horse-power? If not, there may be reasons why not; but I have failed to discover them. I think information on this point would be valuable to science. I had intended to make some observations on the high-pressure engines in the gun-boats, but I must postpone them for a future occasion, with this remark:—That the high-pressure engines whose performance I have investigated are not fair specimens of their class; and any conclusions drawn from them, as to their suitableness for ships of war, must be inconclusive.

I have felt it to be due on my part to the British Association, to bestow some pains on the matters submitted in this Paper, not only as an acknowledgment of the ready attention paid to my suggestion in my absence, both last year and in Dublin, for the appointment of a committee, but also to show what may be done, and what there is to do.

I trust I have shown that there is a practical issue before us worthy of the labour: that these are not the speculations of a theorist unversed in practical life, which, however amusing in the closet, can determine no actual issues, but that they have a vital bearing on questions which now exercise some of the keenest intellects of our day. The science of war has, as we all know, called forth the most practical development of the human mind. At this moment all the resources of mechanical art are stimulated to the utmost to produce, or to perfect, instruments of war. Ships are in this category. Where are the admitted laws which are to guide us? Who can point them out? I, therefore, again suggest the renewal of the powers of the committee appointed at Leeds, with some extension of their objects.

I cannot close this paper without making some attempt to discharge the debt of acknowledgment on the part of science, which I feel to be due to the two noblemen, whose experiments with their yachts have enabled me to make this exposition of what I conceive to be the principle of the screw in its relation to ships. Experiment alone can prove or disprove my positions. But in either event, the Marquis of Stafford and Lord Dufferin are thankworthy, who at some cost have taken a course which *seemed to have* the sanction of science.

Experiments of this nature ought to be undertaken by Government—they, representing the nation, have the largest interest at stake, and the amplest means at command.

If it should turn out that the investigation here unfolded leads to determine the relations between the *direct* thrust of the screw and its *resultant*, and between that and the form of the vessel, one more instance will be added to the many our country offers of the value of voluntary associations, in stimulating individuals in the pursuit of a common object; and I shall have some satisfaction in thus vindicating the claim to be considered a scientific sea-officer, to which I once fancied I had some pretensions, and to which I still attach some value.

Nevertheless, I should not have gone out of my way to make public such investigations as these which have amused my leisure hours, if it had not been for the British Association for the advancement of Science.

C. R. MOORSOM.

Highfield, *August*, 1859.

ON THE MANŒUVRING OF SCREW VESSELS.

By Admiral Paris, C.B., of the Imperial French Navy.

The propelling properties of the paddles and of the screw are very different acccording to the form, mode of acting, and especially the position of the propellers in the ship. A few words will show these differences, and will enable us to deduce the special qualities of both propellers, and thence the methods of making a good use of them for the various purposes of navigation.

The paddle acts at the surface of the water and pushes it in the direction of the keel, when working ahead. Thus the current produced by the resistance of the water is useless to the rudder, because it acts only on the upper part, where it presents no flat surface. It must also be remarked that the action of the paddle will never affect the direction of the ship, unless one immersed more than the other, thus meeting more resistance, or when, as in some ships, one acts in one direction and the other in the reverse, thus causing the ship to turn.

The screw acts on the water by a twisted surface, which, instead of pushing back the water in the direction of the keel gives it a whirling motion and projects it abaft in the shape of a cone, producing a current in the same way that the paddle wheels do; but being below the surface of the water, and the propeller being just ahead of the rudder, the latter receives the impulse of this artificial current which acts before the ship has moved, because the inertiæ makes her resist, for a few minutes, the impulse of the propeller.

Hence a principle is deducible, viz: that the paddle-wheel ship cannot steer *without* moving, and that on the other hand screw ships steer *before* moving, and that even long after the propeller is at work, if any object offers resistance to its translating action.

Another difference arises from the action of the screw, because its blades are oblique to the length of the ship, and all of them are pushing the stern not only ahead or astern, but also sideways, so that if the water were equally resistant close to the surface and below it, the equilibrium of both vertical blades would make the screw act equally throughout its path. But this is not the case, and the water being more resistant as the depth increases, the lower blade finds more difficulty in moving than the upper one, and the stern being acted on sideways by this difference in the resistance, the ship will not move straight ahead, and if the rudder does not balance this effect she will always deviate to the same side when going astern this effect will naturally be more or less energetic according to the immersion of the screw and the relative pitch—for if the screw shaft were at the level of the sea, and the pitch infinite, that is, should the blade be in the place of the axis, the stern will only be deviated and not propropelled—consequently, in the actual state of things, the side action of the screw on the stern is a mixture of the propelling and of the lateral effect; this cannot be avoided, and is only lessened by a deeper immersion, or reduction of pitch, and the direction is according to the side of the thread, so that a right-handed thread deviates the ship to larboard when going ahead, and to starboard when going astern; it is the reverse for a left-handed thread.

From this it would appear at first sight, that the paddle acts much better in making a ship steer well than the screw, and that the disturbances of the screw on the true shipway present obstacles to the management of the ship. But it is not so, and these properties of the screw can be used in such a way, as to make various manœuvres impossible with paddles.

Thus, if a ship is required to turn short at the moment before leaving her anchorage, the paddle vessel will want ropes, or at least sails, if the direction of the wind permits, and her propeller will be used only to resist the wind or to act in the direction of the keel. The screw, however, enables her to turn round on the same place when in a calm, for if the ship has a little more cable out than the depth of water, so that the anchor will still offer a small resistance, and she moves her screw slowly, the anchor holding on, prevents the ship from going ahead, whilst at the same time the screw throws water on the rudder and makes it steer the ship as though she were under way: this is well known, and many vessels are handled in this way to give them the proper direction without moving ahead, and when at the proper point of the compass, they weigh anchor and go ahead.

If she is not at anchor, a screw ship can also turn herself by her own inertia: thus, if the screw backs, the ship will begin to turn her head to starboard, and when she has gone about half her length, reverse the engines, and work them quicker with the helm a-port —the ship will go ahead but turn on the same side—so by repeating several times the same reversing operation, the turn of the horizon will be made much more quickly than would at first be supposed, and the space required to turn in may be lessened at pleasure by shortening each period of the operation.

If there is any breeze the sails can be employed to accelerate the evolution, either by their oblique action, as with the gib or the mizen sail, or by being used only to resist the impulse of the propeller, in order to give it a more energetic oblique action. So with the wind ahead, and the maintopsail bearing on the mast, a stronger current is produced on the rudder's surface, and when the wind is abaft, the same sail being full, a greater speed may be given to the screw in order to make its oblique action stronger and let the ship turn quicker. In the intermediate positions between the head and the back wind, the main-top-sail is directed in such a manner that it is always acting against the screw. These manœuvres of screw ships have been executed several times, and have enabled ships to enter crowded roads and to pass through spaces where ordinarily it would have been impossible to pass.

Ships are sometimes required to remain in one position without dropping anchor; with sails, as with paddles, there is always lee way, and the ship cannot keep the same position unless with a beam wind. It is also difficult to take another ship in tow, as large ships want much time to send their heavy tow ropes on board, and have generally to drop anchor and weigh again when the second one is in tow; this is a very long operation and may be readily avoided by making use of the properties of the screw when the wind is ahead or astern. Suppose for instance, that a ship is intending to take in tow another lying at anchor. She will sheet and hoist her mizen topsail and gallant sail according to the wind, and place herself a short distance ahead of the other, and make her engine work slowly. Thus as the backing force of the mizen sails would be compensated by the heading force of the propeller, the ship acted on by these two equalized and opposite forces will be motionless—but she will steer as well as if making way, on account of the artificial current before alluded to, and may change her direction or remain quite motionless, regardless of the direction of her head, as long as may be desired. This I have done several times when ordered to take ships in tow, and once remained nearly twenty minutes in almost exactly the same position.

This combination of both propelling powers, the sails and the screw, may also be used to maintain the ships with an oblique direction of the wind, two or three points, for example, by bracing properly the mizen top sail; but when there is a slight lee way, and if the wind blows in the direction of the beam, it is the common condition of sailing or paddle vessels standing on.

In many cases it is very useful to be able to back a vessel in any direction, and when able to do so a captain dare go anywhere. With a paddle vessel this is possible for a short distance, by using at the same time some of the sails, but with the screw alone it is impossible on account of the side action above referred to—so in a calm a screw ship cannot follow by her stern the same way she made by her head, she must have room enough to turn completely on herself. Again supposing a vessel is required to remain in the same place with the wind astern, she sheets and hoists her foretopsail and works her screw back; these two forces can be balanced by the throttle valve, and their propelling action brought into equilibrium. But the screw deviates the ship to starboard, and this can be avoided by having larboard braces on the foretopsail, so tha not only the pushing actions but even the deviating ones are entirely balanced. I have remained at rest several times by these means, and once for an experiment for half an hour. It was on board a frigate 74 metres or 226 feet long; she changed her direction only one point and a half of the compass, and varied her position only the distance between two port-holes. With more attention she would have be exactly motionless.

If it is wished to go astern it is very easy to work the ship in the same manner, by ordering the screw to work faster and bracing more the foretopsail, thus the latter will not push too much ahead, and will balance better the deviating action of the screw.

By this method on board of the same frigate, I went astern at a speed of three knots, and with a deviation of one point only in half an honr. The ship was steered as exactly by her foretopsail, properly braced, as by her rudder when going ahead, the only attention being to proportionate the work of the screw to the action of the foretopsail, and to go back slower when the wind is light.

As a natural consequence the Great Eastern will be the most handy vessel afloat, if the properties of the two propellers are usefully employed. Thus, if she wishes to turn round quickly, let the paddle turn astern and the screw ahead, the equilibruim of these two forces will soon be ascertained, then by ordering a quicker or slower motion on either propeller, the artificial current against the surface of the rudder will be obtained without any motion of the ship, and she will then turn on herself very easily. The motion may be accelerated at will by making the two propellers work with more or less energy, but always equally, which is easily done by observing some object on shore or the water alongside, and shntting off the throttle valves at the proper time. But this is not all—she will steer even when going astern, which would be impossible in any other ship, unless a strong breeze were acting on the topsail.

Being a seaman, my thoughts were naturally directed to the method of making good use of the means put into the hands of a captain by the skill of the engineers who invented and made the various engines. So, from one trial to another, and reflecting on the pinciple of the action of the screw, I arrived at a new theory on the manœuvres of these kinds of ships; and to illustrate the difference of their managment from that of paddle vessels, I have arranged in two columns in my "Catechism for Seamen and Steam Engineers" the answers to questions on this subject, which greatly facilitates the comparison; the left column for paddles and the right for the screw. A chapter of 100 octavo pages has been devoted to the elaborating the details of these practical means of managing screw ships as aasily as a horse, and to expose in a clear manner the variety of methods employed with each propeller to make any manœuvre requisite in intricate navigation, and especially on leaving or entering crowded harbours. I should have been glad to see these methods experimented on, or have used them myself if permitted, on board the *Great Eastern,* as this ship is the most interesting problem of modern navigation, and one which involves not only the speed, distance, and economy of transport, bnt also the means of mtnœnvring with facility and security this tremendous body, the largest ever created by man to be moved on the seas.

NOTICE OF SOME EXPERIMENTAL RESEARCHES TO DETERMINE THE DENSITY OF STEAM AT ALL TEMPERATURES.

By WILLIAM FAIRBAIRN, F. R. S., AND THOS. TATE, F. R. A. S.

I propose to give a short sketch of an apparatus and the results of the earlier experiments which in conjunction with my friend Mr. Thomas Tate, I have been investigating by direct experiment, with the intention of determining the law of the density of steam and other condensable vapours, and thus to solve a hitherto almost nntouched problem by an experimental method, which will verify or correct the theoretical speculations in regard to the relation between the specific volnme, and temperature of steam and other vapours. The experiments are being conducted, it is believed, upon an entirely novel and original principle, and one which is applicable at any temperature and pressure capable of being sustained by glass vessels.

For a perfect gas, the law which regulates the relation between temperature and volume is known as Gay Dussac's or Dalton's law, and is expressed by the equation,

$$\frac{V \times P}{V_1 \times P_1} = \frac{458 + t_1}{458 + t} \quad \cdots\cdots \quad (1.)$$

Now the density of steam has been determined with accnracy by direct experiment at the temperature of 212°—and at that temperature only—by the method of Dumas. At 212° Fahrenheit its density is such that its volume is 1670 times that of the water which produced it. Hence, assuming Dalton's law to hold true for steam, and snbstituting these values of volume, temperature and pressure, we get for the volume of steam from a unit of water at any other temperature,

$$V = \frac{1670 \times 15}{670} \times \frac{458 + t}{P}$$

$$\text{Or } V = 37\tfrac{1}{3} \cdot \frac{458 + t}{P} \quad \cdots\cdots \quad (2.)$$

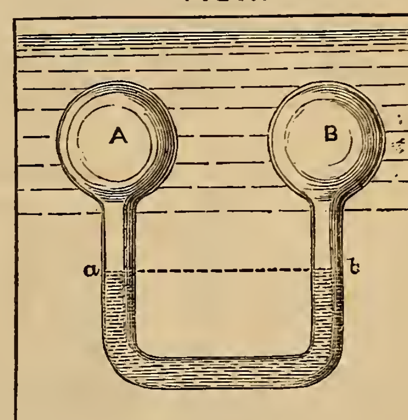
These are the well known and received formulæ from which all the tables of the density of steam have hitherto been deduced, and on which calculations on the duty of steam engines have been founded. Up to the present time, however, this formula has never been verified by direct experiment, nor are the methods hitherto employed, in determining the density of gases and vapours, applicable in this case, except at the boiling temperature of the liquid at the ordinary atmospheric pressure. But, on the other hand, theoretical speculations throw considerable doubt on the accuracy of the above formula when applied to steam and other *condensable* vapours. Several years ago Dr. Joule and Prof. William Thomson announced, as the result of applying the new Dynamical theory of heat to the law of Carnot, that for temperatures above 212° Fahrenheit, there is a very considerable deviation from the gaseous laws, in the case of steam. Later, in 1855, Professor Macquorn Rankine has given a new theoretical formula for the density of steam, independent of Gay Dussac's law, and confirmatory of Professor Thomson's surmise. But as yet these speculations need the evidence and verification of direct experiment.

The density of steam is ascertained by vapourizing a known weight of water in a glass globe of known capacity, and noting the exact temperature at which the whole of the water becomes converted into steam. From these three elements, volume, weight and temperature, the specific gravity is known. But in pursuing this method these two difficulties must be overcome. *First,* the pressure of the steam renders it necessary that the glass globe should be heated in a strong and consequently opaque vessel. *Second,* as steam rapidly expands in volume for any increase of temperature beyond the temperature of saturation, it would in any case be impossible to decide by the eye the temperature at which the whole of the water became vapourized. The temperature of saturation, or temperature at which the whole of the moisture is converted into steam, whilst no part of the steam is *superheated,* must be determined with the utmost accuracy or the results are of no value.

The difficulties thus resolve themselves into finding some other test of sufficient accuracy and delicacy, to determine the point of saturation. This has been overcome by what may be termed the *saturation gauge,* and it is in this that the novelty of the present experiments consists.

To illustrate the principle of the saturation gauge, suppose two globes A and B connected by a bent tube containing mercury at *a b* and placed in a bath in which they can be raised to any required temperature. Suppose a torricellian vacuum to have been created in each globe and 20 grains of water to have

FIG. 1.



been added to A and 30 or 40 grains to B. Now suppose the temperature to be slowly and uniformly raised around these globes; the water in each will go on evaporating, at each temperature being filled with steam of a density corresponding to that temperature, and the density being greater as the temperature increases. At last a point will be reached at which the whole of the water in globe A will be converted into steam, and at *this* point the *mercury column will rise at* a *and sink at* b: this is the saturation test and the cause of its action will be easily seen. So long as vaporization went on in both A and B, and the temperature was maintained nniform, each globe would contain steam of the same pressure, and the columns of mercury *a* and *b*, would remain at the same level. But so soon as the water in A had vaporized and the steam began to *superheat,* the pressure in A would cease to remain uniform with the pressure in B and the mercury columns would at once *fall* and thus indicate the difference. The instantaneous change of the position of the mercury is the indication of the point at which the temperature in the bath corresponds with the saturation point of the steam in A.

To show the delicacy of this test I may instance, at 290° Fahrenheit, the mercury column would rise nearly two inches for every degree of temperature above the saturated point, as the increase of pressure arising from vaporization is twelve times that arising from expansion in snperheating at that point, and a similar difference exists at other temperatures.

The apparatus as employed for experiment, varies according to the pressure and other circumstances of its use. Fig. 2 represents one of the arrangements which has been employed with success. It consists of a glass globe of about 70 cubic inches capacity in which is placed after a torricellian vacuum, has been formed, the weighed globule of water. This globe with its stem is shown at A; this is surrounded by a copper boiler, B B; prolonged by a stout glass tube C C enclosing the globe stem. This copper boiler forms the water and steam bath through which the globe is heated, and in fact correspouds to the second globe B in the former figure. The fluctuating mercury column, or saturation gauge is placed at the bottom of the tube, C C: by the rise of the inner mercury column *a;* and the fall at the same time of the outer mercury column, *b*. As soon as the whole of the water in the globe A, is evaporated, there is an instantaneous *rise* of the *inner* mercury column to restore the balance of pressure, and that progressively with the rise of temperature.

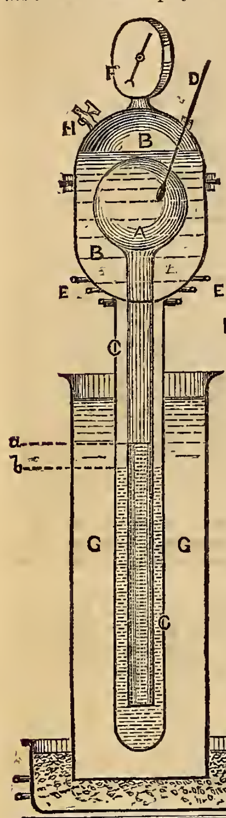


FIG: 2

As an auxilliary apparatus, the boiler is provided with gas-jets, E, to heat it, and with an open oil bath, G, to retain the glass tubes at the same temperature as the boiler; and this oil bath is placed on a sand bath and also heated with gas. A thermometer, D registers the temperature, and a pressure gauge F, the pressure of the steam; aud a blow-off cock H, serves to reduce the temperature when necessary. A number of results have already been obtained; but they are not yet sufficiently advanced to be made public. The following numbers have been, however, approximately reduced from the theorctical formula and the experimental results, and may illustrate the use of this method of research. The most convenient way of expressing the density of steam is by statiug the number of volumes into which the water of which it is composed has expauded. Thus, one cubic inch of water expands into 1,670 cubic inches of steam at 212° Fahr. into 882 cubic inchcs at 251°, and into 400 cubic inches at 304°; and so ou; in this way the following numbers have been computed:—

Temperature.	By formula.	Volume of Steam by Experiment.
244°	1005	896
245°	969	890
257°	790	651
262°	740	680
268°	680	633
270°	660	604
283°	540	490

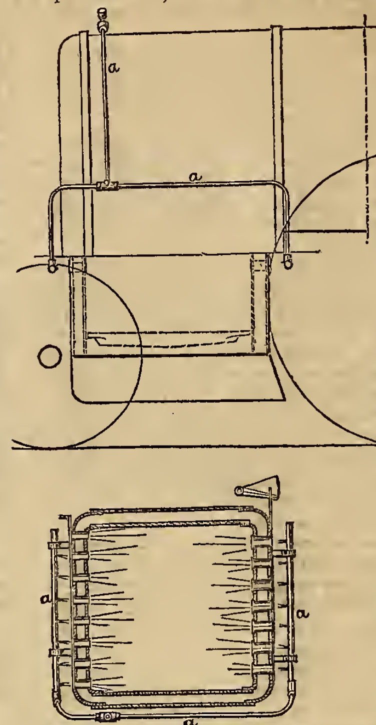
These determinations, at pressures varying from 10 to 50 lbs. above the atmosphere, are not accurate reductions from the experimeutal results, but only approximations. But they uniformly show a decided deviation from the law for perfect gases, and in the direction auticipated by Professor Thomsou. Thc density being uniformly greater than that indicated by the formula. I hope by the time of the next meeting of the associatiou with the assistance of my friend Mr. Tate, to be enabled to lay before the section a series of results, which will fully determine the value of superheated steam, and its density aud volume as compared with pressure—at all pressures varying from that of the atmosphere to 500 lbs. ou the square inch.

ON SMOKELESS COAL-BURNING IN LOCOMOTIVE ENGINES.

By D. K. Clark.

The substitution of coal, as fuel, for coke in locomotives, is not ouly felt to be a commercial necessity for the reduction of expenditure, but is also discovered to be perfectly practicable as a mechanical problem, in conformity with the conditions laid down in the Railway Acts of Parliament, that railway engines shall consume their own smoke. The means of doing so, to be acceptable to a locomotive engine, must be simple in design, facile of application to existing locomotive stock, easy to manage, easy to maintain, efficient in promoting the combustion of coal without smoke, keeping up the steam, and saving expense.

These desirable qualifications, the writer believes, belong to this system of smoke prevention. The whole apparatus is external to the fire-box, and therefore not exposed to heat, and it is controlled iu the most perfect manncr by a single stop-cock. Air is admitted above the fuel by one or more rows of tubes inserted through the walls of the fire-box, and jets of steam are projected through the air-tubes from nozzles $\frac{1}{16}$ inch in diameter, in small steam-pipes placed outside the fire-box, to increase the quantity and force of thc air admitted above the fuel, in order to consume the smoke. The jets of steam are used principally when the engine is standiug, with the aid of a light draught from a ring jet in the chimney, to carry off the products of combustion, aud they may be shut off when not required. The supply of air through the tubes may also be regulated by dampers. The grate bars are placed close together, with narrow air spaces, and the ash-pan and damper are tightly fitted. The level of thc fuel should at all times be below the air-tubes.



Elevation and plau of D. K. Clark's system as applied to the engines of the Great North of Scotlaud Railway.

a a, Steam-pipe.

This system is working, with entire success, on the engines of the Great North of Scotland Railway, at Aberdeen. It is also successfully at work daily (amongst other lines) on several of the engines of the North London Railway, where, as a metropolitan line, the regulations against smoke-nuisance are rigidly enforced. It requires a less weight of coal than the engines formerly required of coke for the same duty, aud thus saves the whole difference in cost of fuel.

The locomotive engine has been variously cut up, in order to suit the views of designers for the combustion of coal without smoke. In the plan before the meeting, the original type of engine promulgated by Mr. Stephenson, and at this day universally adopted, and uusurpassed, is preserved intact; and the locomotive is thus rendered a complete and perfect machine, and entirely meets the great railway necessity of the day—the perfect combustion of coal in railway engines.

After the reading of the papers it was suggested that such members of the Committee as chose to cxamine the apparatus in action, and judge for themselves of its merits, should attend at the Great North of Scotland Railway. Accordingly some of the members of the Committee, through the kindness of Mr. Cowan, the Locomotive Snperinteudeut, had the opportunity of witnessing Mr. Clark's system in action. The result of the trip was very successful. The smoke was most effectually got rid of, by simply opening the valves, and calling into action Mr. Clark's very useful and ingenious apparatus; and to prove its perfect action, it was shut off or put out of action from time to time, when the immediate production of dense and voluminous discharges of smoke testified [to its value. Mr. Cowan stated that he had had the apparatus working for several months, and could testify, not ouly to its efficiency, but of the saviug in fuel effected by its use.

REPORT OF THE PROGRESS OF STEAM NAVIGATION AT HULL.

By James Oldham, M. Inst. C.E., Hull.

In continuation of my report on the progress of steam navigatiou, as connected with the port of Hull, I have to observe that, during the last two years, no very great change has taken place in the number of steamers, although I shall have to state some interesting facts occurring during that time. For generations past Hull has been noted for its Greenland and Davis Straits fishery, which for many years has constitutcd the chief feature of the port; and, at one time, upwards of sixty large ships were sent out, with crews varying from thirty to forty men each, and represeuting a capital for all that concerned the trade, of about £700,000 sterling. In 1818 Hull sent out to the fishery sixty-three ships, which brought home 5,817 tons of oil, and in 1820 sixty ships were sent out, and returned home with 7,782 tons of oil, exclusivc of whaleboue. In this year (1820) the total number of ships at the fisheries, from England and Scotland, amounted to 156; and the entire weight of oil obtained was 18,725 tons, and of whalebone 902 tons. Owing, however, to the introduction of coal gas for the lighting of streets and buildings, and large importations of oils for manufacturiug purposes from the Mediterranean aud other places, together with the scarcity and difficulty of taking the whales, fish-oil became in a great measure superseded, and consequently the fishery nearly abandoned, and an enormous amount of property, once of so much value, almost entirely lost. Within the last two or three years steam has been put into successful requisition to aid the hardy and dauntless mariner in the pursuit of this hazardous calling, and now we have several screw steamships employed; and although some of them are fitted with comparatively small power, they have proved to be possessed of great advantage in the service, and in some instances satisfactory to the owners. We have two descriptions of steam-vessels employed in the fishery; the first the old wooden sailing ships which had been engaged in the service for some years, but which were afterwards fitted with screw machinery and auxiliary steam power. The second, iron-built ordinary screw steam-vessels, bnt which proved, I believe, almost a total failure, the material of which they were built, and the want of strength for such a purpose, proving them altogether unfit to contend with the severity of the climate and rough encounters with the bergs and fields of ice; some becoming total wrecks, while others returned bruised and rent, and with difficulty kept from sinking. A question here arises how far iron ships are calculated to bear the severe frosts of high latitudes, and whether wooden-built vessels, with all their defects, are not the best adapted for such a climate? The screw steam-ship which was first sent from Hull, or any other place, to the fishery as an experiment, was the *Diana*, timber-built, 355 tons, 40-horse power, high pressure, the property of Messrs. Brown, Atkinson, and Co., of Hull. The vessel had been some time engaged in the fishery as a sailing ship, but her spirited owners, thinking an important advantage could be gained, determined upon the adoption of steam power, and at once had the *Diana* fitted for the spring of 1857, by Messrs. C. and M. Earle, who put in the engines, and made the screw to lift out in case of need. The experiment fully answering their expectations, Messrs. Brown, Atkinson and Co., bought the *Chase*, a fine American built ship, of immense strength, and 558 tons. She was fitted by Messrs. Martin, Samuelson and Co., with condensing engines of 80-horse power, and despatched to the fishery in the early part of 1858, and with good results. By the application of steam, ships in this service can now make a voyage, first to Greenland, and afterwards to the Davis Straits. In the commencement of this year several ordinary iron screw steamers were despatched to Greenland, viz., the *Corkscrew*, *Gertrude*, *Emmeline*, and *Labuan*; the latter only of this class, which is the property of Messrs. Bailey and Leetham, had any success; but in consequence of her great strength and peculiar form succeeded in a tolerable way; the others were much damaged, and, as I have already remarked, returned in bad condition. The *Labuan* is 584 tons burthen and 40-horse power.

The next point of interest connected with the steam-ships of the port of Hull refers to alterations made in some of the vessels. The *Emerald Isle*, a paddle timber ship of 1835, the property of Messrs. Gee and Co., originally $135\frac{8}{10}$ long, lengthened 35 feet, with a gain of 14 inches draught of water, and increased capacity for 100 tons dead weight. The *Sultana*, iron screw steam-ship of 1855, the property of the same house, originally 150 feet long, lengthened 30 feet, with a gain of 10 inches draught of water, and an increased capacity of about 100 tons. It is interesting to observe that in both cases we have no diminution of speed through the water, and that both vessels are improved as sea boats. Daily experience teaches the advantage gained, in almost every point of view, by ships of great comparative length. The iron steam-ship *Lion* of Hull, formerly a paddle-boat, 249 feet long, but now converted into a screw-steamer by her owners, Messrs. Brownlow, Lumsden and Co., under the direction of Mr. Anderson, their engineer, exhibits the great advantage gained by the alteration. Her register tonnage is 690, and the total tonnage 1,014. She was formerly fitted with steeple engines of 350 horse power, and had four boilers, two before and two abaft the engines; but these were substituted for direct action engines of 150-horse power, and two of her old boilers replaced, and by this alteration a clear length of hold in mid-ships of 23 feet is gained. She required before the conversion 650 tons of coal for a Petersburg voyage, and consumed from 30 cwt. to 40 cwt. per hour; but now 350 tons for the voyage, and a consumption of 20 cwt. per hour. By the change of machinery, about 130 tons of dead weight is removed from the ship, and she is now able to carry 400 tons more cargo. Her speed is also improved considerably; before the alteration, when drawing on an average 14 feet, the rate was six knots and a-half, but since the change, when drawing even more water they can steam eight knots. Thus a saving in almost all the departments of the ship, and other advantages, have been effected in this important change. During the last two years many fine steamships have been built in Hull, and others are in process of building for English and foreign service, by Messrs. Brownlow, Lumsden and Co., Messrs. C. and W. Earle, and Messrs. Martin, Samuelson and Co. The last named firm are making rapid progress in the building of two large iron paddle ships for the Atlantic Royal Mail Steam Navigation Company, of the following dimensions, power, &c.:—

	Feet.
Length between the perpendiculars	360
Beam moulded	40
Depth	30
Tonnage, builder's measure	2,860
Nominal horse-power	800

These ships are to have three decks, and to be fitted fore and aft for passengers. Speed through the water, twenty miles per hour. They will be of immense strength, and their build and form such as to ensure their becoming fine sea boats. Since the meeting of the British Association, at Dublin, considerable advance has been made in London and other ports in the application of superheated steam, and, I believe, with great success and satisfaction in the results; Hull, however, is acting on the motto, *festina lente*, and before taking a decided step in this important discovery, is anxious to see and adopt the best mode of the application of the principle. being assured that in every onward movement it is better "to make no more haste than good speed." Some attention has been paid to the consumption of smoke in the furnaces of our steam vessels, and with a considerable amount of success. I may here mention the mode of Mr. Ralph Peacock,' of New Holland, Hull, for which he has taken out a patent. It consists of a double furnace-door, the chamber or space between the inner and outer surfaces being five to six inches in width. The inner plate is perforated very full of small holes, and in the outer plate a revolving ventilator is inserted, which is on the principle of that invented by Dr. Hale, to supply close places with fresh air. The apparatus is in use on board the *Helen Macgregor*, one of Messrs. Gee and Co.'s large sea-going steam-ships, and has given very general satisfaction; for by the report of the chief engineer, Mr. McAndrew, a saving of fuel is effected and the steam better sustained. Another great advantage, as reported by the master, Captain Knowles, derived from this invention, is, that on running before the wind, they are never now annoyed and endangered by a dense cloud of smoke in the direction of the ship's course, which, particularly at night time, creates so much risk of collision. This apparatus is also in use on board several other steamers, viz., the *Yarborough* and *Grimshaw*, belonging to the Anglo-French Company, the *Albert*, of Hull, and also a number of river steam-boats. I have great pleasure in noticing also an improvement introduced on board the *Queen of Scotland*, another ship belonging to Messrs. Gee and Co., for the same object by the Chief Engineer, Mr. Smith, and having furnaces of ample capacity, it answers the purpose in a most satisfactory manner. Mr. Smith's mode consists simply in keeping a few inches of the front ends of the bars quite clear and clean from side to side of each furnace, thus admitting at the right place a sufficient amount of air. The report of the master, Captain Foster, is very satisfactory; I have witnessed also the effect of this mode on furnaces of stationary boilers with perfect results. I have now to refer to the application of Silver's marine governor, as applied by Mr. John Hamilton, of Glasgow. Several of these ingenious and efficient instruments are now in use on board steam ships in the port of Hull, giving the highest satisfaction. They are so sensitive in their action, that the slightest pitching motion is at once indicated, and the steam admitted or excluded as the case may be. By the use of this governor, the full power of the engines is in immediate and constant requisition, producing the effect of saving of time, saving of fuel, and prevention of accidents by what is termed racing and otherwise. The ordinary mode, in the absence of the governor, is for the engineer, in stormy weather and heavy seas, continually to stand at the throttle-valves, or, to save himself this trouble, to throttle the engines, and thereby, when the full power of the engines is most required, it is frequently reduced to one-half or less, and consequently there is occasioned a loss of time on the voyage, and the risk of falling on to a lee shore.

The following is a brief statement of the tonnage, &c., of steam vessels belonging to or trading from the port of Hull at the present time. 1st. Sea-going steamers belonging to the port, 22,290 tons register; horse power, 5,824. 2nd. River steamers belonging to the port, 1,050 tons register; horse power, 450. 3rd. Sea-going steamers trading to Hull, but belonging to other ports—and although many changes have taken place—remain much the same as shown in my last report, viz., about 21,200 tons register: horse power, 5,300. River steamers trading to Hull, but belonging to other places, 2,450 tons register; horse power, 1,200. The number and tonnage of sea-going vessels belonging to Hull have increased since my last report. The river steamers belonging to the port remain nearly the same; this is also the case with sea going and river boats belonging to other places, but trading to Hull.

ROYAL INSTITUTION OF GREAT BRITAIN.

ON THE EARTH'S INTERNAL TEMPERATURE, AND THE THICKNESS OF ITS SOLID CRUST.

By William Hopkins, Esq., M.A. LL.D. F.R.S.

If we descend beneath the surface of the earth, and observe the temperature at different depths, it is found that within a depth ranging from 50 to 80 feet, the temperature changes periodically, being affected to that depth by the heat which the earth receives from the sun at different seasons of the year. The annual variation, however, becomes less as the depth increases, till at the depth above mentioned it becomes insensible. At greater depths, the temperature is invariable at each point, but increases with the depth, at the rate, on an average, of 1° (F.), for a depth of between 60 and 70 feet. The best observations which have been made on this subject are those in deep mining shafts and deep artesian wells; the greater the depth the more completely do anomalous influences counterbalance each other. The greatest depths at which such observations have been made in Western Europe, are at Monkwearmouth and Dukinfield in this country; the Puit de Greuelle, at Paris; Mondorff, in the Duchy of Luxembourg; New Seltzwerk, in Westphalia; and at Geneva. At the first two places the observations were made in vertical shafts of coal mines; the depth of the one at Monkwearmouth being upwards of 1800 feet, and that at Dukinfield upwards of 2000 feet; and in both cases the observations were made while the workmen were sinking the shafts, and with every precaution against the influence of any extraneous causes which might affect the observations. The former gave an increase of 1° (F.) for every 60 feet of depth, the latter for about every 72 and 73 feet. The sinking of the Puit de Grenelle was superintended by Arago. The mean increase of temperature was 1° for every 60 feet. At Mondorff the bore was 2,400, being that of an artesian well; the increase was 1° for 57 feet. At New Seltzwerk the artesian well, penetrating to the depth of 2100 feet, giving an increase of 1° (F.) for 55 feet. The average of these is very nearly 1° for 60 feet. Numerous other observations are confirmatory of those results, though observations at smaller depths present many anomalies indicating the operation of local causes.

If a sphere of very large dimensions, like the earth, were heated in any degree and in any manner, and were left to cool in surrounding space, it is shown, by accurate investigation, that after a sufficient and very great length of time, the law according to which the temperature would increase in descending beneath the earth's surface, within depths small compared with the earth's radius, would be—that the increase of temperature would be proportional to the increase of depth. This coincides with the observed law, if we neglect the anomalous irregular variations which are found to exist more or less in each locality. Now according to this law, the temperature at the depth of 60 or 70 miles would probably be sufficient to reduce to a state of fusion nearly all the materials which constitute the earth's external solid envelope; and hence it has been concluded, that the earth probably consists of a central molten mass, as a fluid nucleus, and an external solid shell, of not more than 60 or 70 miles in thickness: and some geologists, desirous of rendering the conclusion the foundation of certain theories, have considered the thickness even less than that now mentioned.

This conclusion, however, rests on reasoning in which an important element is wanting. It involves the hypothesis that the *conductive power* of the rocks which constitute the lower portions of the earth's crust, is the same as that of the rocks which form its upper portion. This conductive power of any substance measures the facility with which heat is transmitted through it; and it is easily proved, by accurate investigation, that when the same quantity of heat passes through superimposed strata of different conductive powers, the increase of depth corresponding to a given increase of temperature (as 1°), is in any stratum proportional to the conductive power. Consequently, if the conductive power of the lower portions of the earth's solid crust be greater than that of the thin upper portion of it through which man has been able to penetrate, the depth to which we must proceed to arrive at a certain temperature (as that of fusion for the lower rocks) will be proportionally greater. The precise nature of the rocks situated at a great depth can only be judged of by analogy with those which are accessible to us; but those geologists who adopt the conclusion of the extreme thinness of the earth's crust, will doubtless admit that its inferior part must be of igneous origin, and must therefore be allowed to bear a certain resemblance to igneous rocks on the surface of the earth. Mr. Hopkins had recently made a great number of experiments on the conductive powers of various rocks. That of the softer sedimentary rocks, which are great absorbents of water, is very much increased by the quantity of moisture they contain; but taking calk, one of the best absorbents, its conductive power, even when saturated, is not half so great as that of some of the igneous rocks on which Mr. Hopkins had experimented. Calcareous, argillaceous, and siliceous substances reduced to fine powder, stand, with reference to their conductive powers, in the order in which they are now mentioned, the conductivity of the first being the least; and when in a compact state, all that contributes to give a hard and crystalline character to the substance, and continuity to the mass through which the heat is conducted, increases the conductive power. These considerations lead to the conclusion that the conductivity of the inferior portions of the earth's solid crust must be much greater, and may be very much greater, than that of the less consolidated and mere superficial sedimentary beds. Moreover, the temperature of fusion of certain substances, as Mr. Hopkins had shown by experiment, is much increased by great pressure; and by analogy it may be concluded, that such would, at least in some considerable degree, be the case with the mineral matter of the earth's crust. The chalk is that formation in which the most numerous and some of the best observations on terrestrial temperatures have been made; and it would seem impossible to conclude from actual experiment and the considerations above stated, that its conductive power can exceed one third of that of the inferior rocks, and may not improbably be a considerably smaller fraction of it. Now the increase of depth in the chalk corresponding to an increase of 1° (F.) is well ascertained to be very nearly 60 feet, and therefore the rate of increase in the inferior rocks must probably be at least three times as great as in the chalk, and may be very considerably greater still. Hence, supposing that the thickness of the solid crust would be about 60 miles, if the conductive power of its lower portion were equal to that of chalk, its actual thickness must probably be at least about 200 miles, and may be considerably greater, even if we admit no other source of terrestrial heat than the central heat here contemplated.

There is also another way of investigating the thickness of the earth's crust, assuming the whole terrestrial mass to consist of a fluid nucleus inclosed in a solid envelope. If the earth were accurately spherical, instead of being speroidal, its axis of rotation would always remain exactly parallel to itself, on the same principal as that on which the gyroscope preserves, in whatever position it may be held, the parallelism of the axis about which it rotates. But the attraction of the sun and moon on the protuberant equatorial portions of the earth's mass causes a progressive change in the position of the earth's axis, by virtue of which the North Pole, or that point in the heavens to which the northern extremity of the earth's axis is directed, instead of being stationary, describes a circle on the surface of the heavenly sphere about a fixed point in it called the pole of the ecliptic with a radius of nearly 23½°, equal to the inclination of the equator to the ecliptic, or *obliquity*. The whole of this revolution is completed in about 25,000 years; but, as follows from what has just been stated, without any change, beyond small periodical ones, in the obliquity. A corresponding change of position must manifestly take place also in the position of the equinoxes, which have thus a motion along the ecliptic in a direction opposite to that in which the signs of the zodiac are reckoned, completing a revolution in the period above mentioned of 25,000 years. It is called *the precession of the equinoxes*.

This precessional motion has been completely accounted for under the hypothesis of the earth's entire solidity, and that of a certain law according to which the earth's density increases in approaching its centre; but some years ago Mr. Hopkins investigated the problem with the view of ascertaining how far the observed amount of precession might be consistent with the existence of a fluid nucleus. The result was, that such could only be the case provided the thickness of the solid shell were much greater than that which, as before stated, has been supposed by many geologists. The numerical result was, that the least admissible thickness of the crust must be about one-fifth of the earth's radius; but without assigning any great importance to an exact numerical result, Mr. Hopkins had a full confidence in the investigation, as showing that the thickness of the crust could not be so small as 200 or 300 miles, and consequently that no geological theory can be admitted which rests on the hypothesis of the crust being nearly as thin as it has been frequently assumed to be.

The influence of the interior fluidity on the precessional motion above described, s due to the difference between the motions which the attractions of the sun and moon tend to produce on a solid mass in one case, and a fluid mass on the other. It has been recently, stated as an objection to this investigation, that the interior fluid mass of the earth *may* move in the same manner as if it were solid. The only reply which could be given to such an objection was, Mr. Hopkins conceived, that it was mechanically impossible that these motions should be the same, though the resulting precessional motion for the solid crust, under certain conditions, to be determined only by the complete mathematical solution of the problem, might be the same as if the whole mass were solid. The effect of the attractions of the sun and moon also depends on the ellipticity of the inner surface of the solid shell; and it has been said that since that ellipticity depends on the law of the earth's density, which can only be imperfectly known, no result can be depended on which involves that ellipticity. This was not a correct statement of the problem. It was assumed in the solution referred to, that the ellipticity of the inner surface would depend partly on the law of density, and partly on the forms of the isothermal surfaces. Mr. Hopkins had supposed it possible, at the time he was engaged in this investigation, that a surface of *equal solidity* might approximate to a surface of *equal pressure;* he has now experimental reasons for believing that it must approximate much more nearly to an internal surface of *equal temperature.* Now for depths greater, probably much greater, than those which have often been supposed to correspond to the thickness of the earth's solid crust, there is no doubt that the internal isothermal surfaces have a greater ellipticity than the external surface itself; a conclusion which is independent of the law of density. Hence, a like conclusion will hold with reference to the internal surface of the shell, if it approximate sufficiently to the surface, of equal temperature; and this is the conclusion most unfavourable to the thin shell supposed by some geologists. Restricting the interpretation, then, of Mr. Hopkins's results to the question, whether the earth's solid shell be as thin as some geologists have supposed, or at least several hundred miles in thickness? (and this is the only question of geological importance)—Mr. Hopkins denied the validity of either of the objections above stated.

Thus, both the modes of investigation which had been described, lead to like conclusions respecting the least thickness which can be assigned to the solid envelope of our globe. It must be much greater than geologists have frequently imagined it to be.

ON THE TRANSMISSION OF HEAT OF DIFFERENT QUALITIES THROUGH GASES OF DIFFERENT KINDS.

John Tyndall, Esq. F.R.S. Professor of Natural Philosophy Royal Institution.

Some analogies between sound and light were first pointed out: a spectrum from the electric light was thrown upon a screen—the spectrum was to the eye what an orchestra was to the ear—the different colours were analegous to notes of different pitch. But beyond the visible spectrum in both directions there were rays which excited no impression of light. These at the red end excited heat, and the reason why they failed to excite light probably was that they never reached the retina at all. This followed from the experiments of Brucke and Knoblauch. These obscure rays had been discovered by Sir Wm. Herschel, and the speaker demonstrated their existence by placing a thermo-electric pile near to the red end of the spectrum, but still outside of it. The needle of a large galvanometer connected with the pile was deflected and came to rest in a position about 45 degrees from zero. A glass cell, containing the transparent vitreous humour of the eye of an ox, was now placed in the path of the rays: the *light* of the spectrum was not perceptibly diminished, but the needle of the galvanometer fell to zero, thus proving that the obscure rays of the spectrum, to which the galvanometric deflection was due, were wholly absorbed by the humours of the eye.

Reference was made to the excellent researches of Melloni. In a simple and ingenious manner he had proved the law of inverse squares to be true of radiant heat passing through air, and the eminent Italian inferred from his experiments that for a distance of 18 or 20 feet, the action of air upon radiant heat was totally inappreciable. This is the only experimental result now known regarding the transmission of radiant heat from terrestrial sources through air; with regard to its transmission through other gases it was believed that we were without any information.

It was, however, very desirable to examine the action of such media—desirable on purely scientific grounds, and also on account of certain speculations which had been based upon the supposed deportment of the atmosphere as regards radiant heat. These speculations were originated by Fourier, but it was to M. Pouillet's celebrated Memoir, and the recent excellent paper of Mr. Hopkins, to which we were indebted for their chief development. It was supposed that the rays from the sun and fixed stars could reach the earth through the atmosphere more easily than the rays emanating from the earth could get back into space. This view required experimental verification, and the more so, as the only experiment we possessed was the negative one of Melloni, to which refereuce has been already made.

The energetic action of the solid and liquid compounds into which the element hydrogen enters, suggested the thought that hydrogen gas might act more powerfully than air, and the following means were devised to test this idea. A tube was constructed, having its ends stopped air-tight by polished plates of rock-salt held between suitable washers, which salt is known to be transparent to heat of all kinds; the tube could be attached to an air-pump and exhausted, and any required gas or vapour could be admitted into it. A thermo-electric pile being placed at one end of the tube, and a source of heat at the other, the needle of an extremely sensitive galvanometer connected with the pile was deflected. After it had come to rest, the air was pumped from the tube, and the needle was carefully observed to see whether the removal of the air had any influence on the transmission of the heat. No such influence showed itself—the needle remained perfectly steady. A similar result was obtained when hydrogen gas was used instead of air.

Thus foiled, the speaker put his questions to Nature in the following way; a source of heat, having a temperature of about 300° C., was placed at one end of the tube, and a thermo-electric pile at the other—a large deflection was the consequence. Round the astatic needle, however, a second wire was coiled, thus forming a so-called differential galvanometer; a second pile was connected with this second wire, so that the current from it circulated round the needle in a direction opposed to that of the current from the first pile. The second pile was caused to approach the source of heat until both currents exactly neutralised each other, and the needle stood at zero. Here then we had two powerful forces in equilibrium, and the question now was whether the removal of the air from the tube would disturb this balance. A few strokes of the air-pump decided the question, and on the entire removal of the air the current from the pile at the end of the tube predominated over its antagonist from 40° to 50°. On re-admitting the air the needle again fell to zero; thus proving beyond a doubt that the air within the tube intercepted a portion of the radiant heat.

The same method was applied with other gases, and with most remarkable results. Gases differ probably as much among themselves with regard to their action upon radiant heat as liquids and solids do. Some gases bear the same relation to others that alum does to rocksalt. The speaker compared the action of perfectly transparent coal-gas with perfectly transparent atmospheric air. To render the effect visible to the audience, a large plano-convex lens was fixed between two upright stands at a certain height above a delicate galvanometer. The dial of the instrument was illuminated by a sheaf of rays from an electric lamp. the sheaf being sent through a solution of alum to sift it of its heat, and thus avoid the formation of air-currents within the glass shade of the instrument. Above the lens was placed a looking-glass, so inclined that the magnified image of the dial was thrown upon a screen, where the movements of the needle could be distinctly observed by the whole audience. Air was first examined, the currents from the two piles being equilibrated in the manner described, the tube was exhausted, and a small but perfectly sensible deflection was the result. It was next arranged that the current from the pile at the end of the tube predominated greatly over its antagonist. Dry coal-gas was now admitted into the tube, and its action upon the radiant heat was so energetic, the quantity of heat which it cut off was so great, that the needle of the galvanometer was seen to move from about 80° on one side of zero to 80° on the other. On exhausting the tube, the radiant heat passed copiously through it, and the needle returned to its first position.

Similar differences have also been established in the case of vapours. As representatives of this diverse action, the vapour of ether and of bisulphide of carbon may be taken. For equal volumes, the quantity of heat intercepted by the former is enormously greater than that intercepted by the latter.

To test the influence of *quality*, the following experiment was devised. A powerful lime light was placed at one end of the tube, and the rays from it, concentrated by a convex lens, were sent through the tube, having previously been caused to pass through a thin layer of pure water. The heat of the luminous beam excited a thermo-electric current in the pile at the end of the exhausted tube; and this current being neutralised by the current from the second pile, coal-gas was admitted. This powerful gas, however, had no sensible effect upon the heat selected from the lime light; while the same quantity of heat, from an obscure source,* was strongly affected.

The bearing of this experiment upon the action of planetary atmospheres is obvious. The solar heat possesses, in a far higher degree than that of the lime light, the power of crossing an atmosphere; but, and when the heat is absorbed by the planet, it is so changed in quality that the rays emanating from the planet cannot get with the same freedom back into space. Thus the atmosphere admits of the entrance of the solar heat, but checks its exit; and the result is a tendency to accumulate heat at the surface of the planet.

In the admirable paper of M. Pouillet already referred to, this action is regarded as the cause of the lower atmospheric strata being warmer than the higher ones; and Mr. Hopkins has shown the possible influence of such atmospheres upon the life of a planet situated at a great distance from the sun. We have hitherto confined our attention to solar heat; but were the sun abolished, and did stellar heat alone remain, it is possible that an atmosphere which permits advance, and cuts off retreat, might eventually cause such an accumulation of small savings as to render a planet withdrawn entirely from the influence of the sun a warm dwelling-place. But whatever be the fate of the speculation, the experimental fact abides—that gases absorb radiant heat of different qualities in different degrees; and the action of the atmosphere is merely a particular case of the inquiry in which the speaker was at present engaged.†

* The *quantity* of heat is measured by the amount of the galvanometric deflection which it produces; its power of passing through media may be taken as a test of *quality*.

† Whilst correcting the proof of this abstract, I learned that Dr. Franz had arrived at the conclusion that an absorption of 3·54 per cent. of the heat passing through a column of air 90 centimeters long takes place; for coloured gases he finds the absorption greater; but all colourless gases he assumes show no marked divergence from the atmosphere.—*Poggendorff's Annalen* xciv. p. 337.

ASSOCIATION OF FOREMEN ENGINEERS.

The ordinary monthly meeting of the Association of Foremen Engineers took place on the 1st Oct. ult., at 35, St. Swithin's Lane, City, Mr. Joseph Newton presiding. The attendance of members on the occasion was, however, less numerous than would have been wished, considering the interest of the subject to be discussed—the Rifle Bayonet. Several honorary members having been elected, ordinary ones nominated, and the routine duties gone through by the Secretary; the President called upon Mr. C. F. Hayes, of Enfield, who proceeded, in a lucid, minute manner, to explain the various operations, and the various mills and machines through which the portions of iron and steel composing the socket and the blade of a rifle bayonet must pass before being issued for active service Instead of providing himself with illustrative diagrams as is usual in similar cases, Mr. Hayes came armed with a rifle from the stores at Enfield—a beautifully finished weapon with bayonet complete; Colonel W. M. Dixon having kindly permitted the arrangement. As the reader advanced into the intricacies of his subject, the bayonet was handed round to the assembled members, and served much to simplify the extracts given. The number of processes in the making of a bayonet is very great, but Mr. Hayes succeeded in communicating to his hearers a complete theoretical knowledge of them all.

Considerable applause followed the reading; and after a discussion—embracing a wider range than the mere mechanical *modus operandi* as regards the production of rifle muskets—a vote of thanks was unanimously accorded to Mr. Hayes.

Mr. Newton next appealed to the Association to acknowledge, by a distinct vote of thanks, the courtesy exhibited by the worthy superintendent of the small arms factory at Enfield—Colonel W. M. Dixon—in allowing the admirable specimen of Enfield workmanship, now lying on their table, in the form of a rifle, to be sent for their instruction. It was not the first obligation which had been conferred by that gentleman upon the Society of Foremen Engineers, and they had reason to thank him therefore. In sending a pattern musket to assist Mr. Hayes on this occasion, he has himself set a pattern to those in high places and to employers, which he (the president) trusted would be copied. Mr. Keyte of the Royal Arsenal, Woolwich, seconded the proposition, which was carried by acclamation. The members separated shortly after.

CORRESPONDENCE.

We do not hold ourselves responsible for the opinions of our Correspondents.—Ed.

CHEAP STEAM-ENGINES.

To the Editor of the Artizan.

Sir,—I lately addressed to the President of the Board of Trade the following letter, feeling that the subject there treated of ought to be brought prominently before them, late events showing that something of the kind I have suggested is daily becoming more and more required.

Should you be able to afford the necessary space in your valuable journal for its publication, I think it would do the object I have advocated some good, by inducing others to give the benefit of their views on the subject, so that by our united endeavours something may be decided on, and put in force, which may tend to restrain the increasing evil I have complained of.

I am also induced to send this letter for publication in order that the attention of engineers generally may be directed to the increasing necessity daily manifested, of some decided and definite rule for the construction of boilers and machinery, which at present does not exist; and serves to show that the rules of proportion, &c., for engines and boilers, if of given size, are capable of any amount of variation, with the same results, which I cannot think is a creditable state of affairs for the engineering science of this country.

Apologising for trespassing on your valuable space, I am, Sir, your obedient servant, FREDERICK YOUNG, C.E.

Trafalgar-square, Brompton, S.W.,
Oct. 28th, 1859.

To the Right Hon. the President of the Board of Trade.

Sir,—The rapidly extending employment of steam engines of all descriptions, and for nearly all purposes, in this country, and also abroad, is unfortunately causing an immense and increasing manufacture of what are termed "cheap" engines, and engines and machinery "for exportation," which, in nine cases out of ten, are far more fit to be broken up than used, and from the employment of these, several serious accidents have lately occurred in this country.

The manufacture of these engines and machinery, especially those called "Agricultural," is in the hands of men who are not engineers by profession—have not consequently the knowledge most required for the work in which they are engaged, but are most of them mere "implement makers," who, from seeing the tendency to their extended use, have been induced to go into their manufacture as a profitable trade, and in consequence, as is too frequently the case, these engines exhibit not only a faulty design—a great disregard of many sound and most important engineering principles, especially in regard of proportion and distributing the various strains to which they are subject—but what is far worse, the employment of inferior materials and bad workmanship, extending even, as was shown on a late occasion, to the entire omission of some of the most necessary portions of such engines, and on the proper arrangement of which the safety of all engines, using high-pressure steam, mainly depends.

The numerous fatal accidents which have occurred of late with these engines, and which seem to be on the increase (though certain ignorant makers advertise them as capable of being "easily worked by an intelligent farm labourer"), render it imperatively necessary that there should be some independent supervision over their manufacture; and it would be a great thing if the makers of each description of engine were obliged to submit their design for the inspection and examination of a duly qualified engineer, who should certify that engines made on this design were correct in principle, and that no dangerous plans of construction were adopted in them, so that no engine should be allowed to be made except from a certified design, or sold without a certificate from an authorised engineer or inspector, who shall have first examined and been satisfied of the proper quality of the material and workmanship.

The Royal Agricultural Society of Englaud has, it is true, done something towards elevating the manufacture of agricultural engines generally by their prizes, &c.; but beyond the trial and inspection each year, of what are known to be "Racing Engines," especially got up for these occasions, and which, iu no case except form, at all resemble the engines usually sold, have in no way attempted to guarantee the safety of the public and nsers of these engines, by certifying either their principles of construction, quality of material or workmanship, or establishing any check on their manufacture or sale, except limiting the pressure of the steam used to about 45lbs iu the inch—a precaution of little or no use, *unless there be some means of enforcing the construction of boilers strong enough to carry it, for which purpose no means at present exists.*

There can be no doubt that cheap engines, that is to say, good, sound, safe, and useful engines of good material and workmanship, at a low and reasonable price, are highly desirable; but it is far more so to see that this cheapness, so mnch vaunted by some makers, be not, as is too frequently the case, obtained by the employment of a faulty principle, an inferior material, bad workmanship, or diminishing the number of parts necessary to secure its proper strength, by means of which a certain amonnt of saving arises, but the safety of the engine is destroyed, and the lives of persons endangered.

It is not desired to interfere in any way with the free carryiug out of any fit and proper designs which are, or may be introduced, but to establish proper rules and proportions for each class of engine and boiler, somethiug similar to the plan carried out for shipping by Lloyds, from which no maker should be allowed to depart, except on really valid grounds; and also most especially to define the the quality of material to be used for boilers, so that there may be some check on the present reprehensible system, which enables each maker to use what material he pleases, without regarding the safety of the public, and inflicts no punishment on such scandalous conduct.

No plan can be called an improvement in machinery, which, to gain one point, endangers another—perhaps a more important one. At the present time it is much the fashion for various agricultural engine makers to boast that an engine of a given size or power, made by them, is *lighter* than a similar one made by another maker. Such may probably be the case; but how is this superior advantage to be obtained? Is it obtained without taking away or detracting from, another more important one, by which the engine is made weaker aud consequently more unsafe? I think not!

How often has it not been found, that they are fitted with fewer stays, lighter plates (perhaps also of an inferior quality), and a dozen other small things apparently in themselves, but all of which are of great importance to the safety of the engine, and which in ninety-nine cases out of a hundred, are overlooked by the purchaser, as much from want of knowing what should, and what should not be, as from how to detect them?

How often has it not been found that a bright, showy coat of paint, and a little extra polish and bright work, will euable a worthless and dangerous engine to be sold a dozen times over; whilst a first-class engiue, in point of material, workmanship, principle, and proportion, may stand by its side without being looked at, if it be not also meretriciously got up for the purpose?

It appears to me that the most efficient means of preventing these occurrences would be to require each present and future maker to submit his plans to the inspection of a qualified engineer, or committee of engineers, by whom a specification of the proportion of the various parts, the quality of the material to be used, and other particulars should be drawn up and settled, and printed forms of such specifications should be furnished to each maker, who would be bound, under a heavy penalty, not to depart from it; and the uame of each maker should be registered, and a certificate of his registration and liability be given him, to enable him to show that he is a duly qualified maker of safe and correct engines.

It would further be necessary to require that each engine, when sold, or completed, should be accompanied with one of the above-meutioued printed specifications, which should be signed by one of the duly qualified inspectors, certifying that he had examined the said engine, aud found everythiug in accordance with such specification. Thus there would be some safeguard to the public, and the purchasers of such engines, who are at present totally unprotected.

One cannot fail to be struck, looking over the published lists of the various makers, with the want of uniformity in proportions, for each engine of a given size, by each maker, as well as the trivial grounds ou which each claims some superiority over another maker, all of which would be avoided by the arrangement I have described.

Possibly a little opposition might be experienced at the first start, but I am convinced all the lowest and well disposed makers would join in such an arrangement, as it would be a means of stopping the present uuseemly state of thiugs, and getting rid of some of those whose present unrestrained proceedings are productive of great evil, both here and abroad, by giving a bad name to the productions of this country, as well as being most destructive to life and property on numerous occasions.

I have the honour to be, Sir, your most obedient servant,

Trafalgar-square, Brompton, S.W. FREDERICK YOUNG, C.E.
Oct. 25th, 1859.

THE GREAT EASTERN.

To the Editor of the ARTIZAN.

SIR,—In the brief obituary notice of the late Mr. Brunel, in the ARTIZAN for last month, I observe it is there stated that the Great Eastern was of his "creation."

Now this is a mistake, for he neither created or even originated this uoble ship and though she was designed and built by Mr. Scott Russell, yet ueither has he the credit of having originated her.

It is to a Mr. W. Radford R. N. that the merit is due of having first propouuded the priuciples, and peculiar advantages to be derived from ships of great size, and the very words and arguments he used in a little work on this subject, written by him, and published in 1840 by Weale of Holborn, have since been adopted as his own by Mr. Brunel in his prospectus of the Great Eastern in 1852-3.

I observed by his speech at the dinner on board the Great Eastern, on the 8th of August 1859, that this book is unknown, or forgotten by Mr. Scott Russell, for he then stated "that the original conception of a large steam-ship to carry her own coal ou the longest voyage, was absolutely and entirely Mr. Brunel's," but I think the perusal of this little work by him, and the public generally, will induce them to give to Mr. Radford the credit which is so justly his due, and though he may be a comparatively unknown individual, he should not be put aside, in order that those better known may take his place.

I am, Sir, &c.,
"PALMAM QUI MERUIT FERAT."

London: October 25, 1859.

REVIEWS AND NOTICES OF NEW BOOKS.

A Manual of the Steam Engine and other Prime Movers. By W. J. M. Rankine, C.E., L.L.D., F.R.S., &c. London and Glasgow: Richard Griffin and Co., 1859.

THIS last production of the prolific pen of Professor Rankine, following so rapidly upon his "Applied Mechanics," which work was noticed at considerable length in the ARTIZAN, at least testifies to the industry of the author. The preseut manual has been received too recently to admit of our doing more on the present occasion than to recommend it to the attention of the engineer, the practical mechanic, and the student in mechanical science, as containing explanations of many of the more recent experiments and their results, connected with the mecbauical action of heat and other subjects of like interest which have not hitherto fouud their way iu a collected form iuto works of practical science. In addition to these and other poiuts which will strike the reader as features in the present work, the very large and useful collectiou of tabulated and other informatiou of general interest, required for ready reference, will be found interspersed throughout the work, and the tables given at the end of the book will be found of especial use by those engaged in the present movements connected with the superheating of steam, steam jacketing, surface coudeusation &c. We hope upon some early occasion to be able to do ample justice to Professor Raukine's "Manual of the Steam Engine, and other Prime Movers," and to quote largely therefrom.

A Practical Treatise on the Manufacture and Distribution of Coal Gas. By Samuel Clegg, Juu., M. Inst. C.E., F.G.S. Third edition. London: John Weale, 1859.

The reputation of the late Mr. Clegg's treatise on the manufacture of coal; gas, &c., is world-wide; and we hail with considerable satisfaction the appearance of a third editon, which has been produced for Mr. Clegg's widow, and edited by Mr. Rutter aud Mr. Bakewell. Cousiderable improvements and additions have been effected, and tbe scientific description of the manufacture of coa gas, as at preseut couducted is fully detailed.

The Architect's and Mechanic's Journal. Published monthly by Alexander Harthill, Fulton Street, New York. Vol. 1, No. 1.

This is the first number of a mouthly publication devoted to Arbitectural and Mechanical matters. It is very creditably got up, and contains some admirably executed woodcuts, and one iu particular, is remarkable for minuteness and correctness of the detail, being from a pbotograph ou wood by Price's Patent Process. The subject of the engraving is the splendid pile of buildiugs known as the Americau House (or hotel) at Boston. The wood block is prepared and introduced iuto the camera, and is afterwards engraved, thus effecting considerable economy of time as well as money in drawing or transferring, whilst the most miuute lines and shadings are obtained with accuracy which it is impossible for the human hand and eye to produce.

We heartily wish success to the New York *Architect's and Mechanic's Journal*

N. B.—We are compelled to defer until next mouth, various reviews and notices of new books, which have reached us too late to enable us to reserve space for insertion in the present number.

LIST OF NEW BOOKS AND NEW EDITIONS OF BOOKS.

ATOMIC WEIGHTS H=1, O=16. On card, 4to., 3d. (J. H. Parker.)

BLAKELY (Captain)—Letter to the Secretary of State for War, claiming the Original Invention of an indispensable feature of the Armstrong Gun, with an authentic description of the Weapon. 8vo., pp. 54, small, 1s. (Ridgway.)

BURNETT (A.)—Tillage, a Substitute for Manure; illustrated by the Principles of Modern Agricultural Science. Post 8vo., pp. 200, cloth, 5s. (Whittaker.)

CROMPTON (S.)—The Life and Times of. And Inventor of the Spinning Machine called the Mule; by Gilbert French. Post 8vo., pp. 300, cloth, 5s. (Simpkin.)

DRILL and RIFLE INSTRUCTION for Volunteer Rifle Corps, by authority of the Secretary of State for War. 12mo., pp. 60, cloth, 6d. (Clowes.)

ENGLISH CYCLOPÆDIA (The).—A New Dictionary of Universal Knowledge, Arts and Seienees. Vol. 2. Condueted by Charles Knight. 4to., pp. 1020., cloth, 12s. (Bradbury.)

FAMILY CYCLOPÆDIA (The).—A Complete Treasury of Useful Information on all Subjects bearing upon the Common Interests and Daily Wants of Mankind; with full Instructions, Drawings, and Specifications for the Construction of Cottages, Dwelling-houses, and Villas, &c. Post 8vo., pp. 340, cloth, 3s. 6d. (Ward and Lock.)

FISON (Mrs.)—Handbook of the British Association for the advancement of Science. By Mrs. W. Fison. Post 8vo., cloth, 2s. 6d. (Longman.)

GRANTHAM (J.)—On Iron Ship Building; with Practical Examples and Details, in twenty-four Plates: together with Text containing Description, Explanations, and General Remarks, for the use of Ship Owners and Ship Builders. 2nd edit., folio, sewed (with Text, 12mo., cloth, limp) 25s. (Lockwood.)

GRIFFITHS (F. A.)—The Artillerist's Manual, and British Soldier's Compenium. 8th edit., 12mo., pp. 364, cloth, 7s. 6d. (Allen)

HARTLEY (W. G.)—A hand book for Rifle Volunteers. 18mo., pp. 250, cloth, 7s. 6d. (Saunders and Otley.)

HAWES (Captain)—Rifle Ammunition; being Notes on the Manufacture, as conducted at the Royal Arsenal at Woolwich. 14s. (Mitchell.)

KENNEDY (S.)—A Few More Notes on the Defences of Great Britain and Ireland from Foreign Invasion. By Lieut.-General Shaw Kennedy. Intended as a Supplement to the third edition of "Notes on the Defences of Great Britain and Ireland." 8vo. pp. 36, sewed, 1s. (Murray.)

LAURIE (J.)—Tables of Simple Interest at 5, 4½, 4, 3½, 3, and 2½ per cent. per annum, from 1 Day to 365 Days; 1 Month to 12 Months; 1 Year to 12 years; each Table advancing successively by Single Pounds from One Pound to One Hundred Pounds, by Hundreds to One Thousand Pounds, &c.; also Tables of Compound Interest, and Interest on large sums for a Single Day at the above Rates, with Copious Tables on Commission or Brokerage from one-eighth to ten per cent. accommodated with a new Time Table. By James Laurie. 24th edit., 8vo., pp. 410, cloth, 21s. (Hall.)

MECHI (J. J.)—How to Farm Profitably; or, the Sayings and Doings of Mr. Alderman Mechi; with illustrations. New edit. with additions. 12mo., pp., 310, cloth, 2s. 6d., half-bound, 3s. (Rontledge.)

MOORE (R.)—The Ventilation of Mines. 8vo., cloth, 5s. (Hamilton.)

NEEDHAM (C. R.)—A Synopsis of the Physiology of Articulation; with Suggestions for Representation adapted to Reporting by Machinery, and for Telegraphic purposes. 8vo. pp. 20, sewed, 1s. (Simpkin.)

NUGGETS from the OLDEST DIGGINGS; or, Researches in the Mosaic Creation, pp. 140, cloth, 3s. 6d. (Hamilton.)

QUESTED (J.)—The Art of Land Surveying, explained by short and easy rules, for the use of Farmers, Stewards, &c. 5th edit., 12mo., pp. 106, cloth, 3s. 6d. (Relfe.)

SAMUEL.—Wool and Woollen Manufacturers of Great Britain; the rise, progress, and present position. 8vo. pp. 172, cloth, 10s. 6d. (Piper.)

SMOKE (Nuisance of) from Locomotive Engines on Railways, Correspondence on the. Demy 8vo., pp. 16, sewed, 6d. (Ridgway.)

SPRENT (J.)—A New Map of Tasmania and the adjacent Islands. Case, 42s. (Stanford.)

TODHUNTER (I.)—Spherical Trigonometry, for the use of Colleges and Schools; with numerous Examples. Post 8vo., pp. 114, cloth, 4s. 6d. (Macmillan.)

TRONSON (J. M.)—Personal Narrative of a Voyage to Japan, Kumtchatka, Siberia, Tartary, and various parts of China, with Charts, Views, &c. 8vo., pp. 415, cloth, 18s. (Smith and Co.)

TURREFF (G.)—Antiquarian Gleanings from Aberdeenshire Records. Post 8vo., cloth, 5s. 6d. (Hamilton.)

WALLACE (Prof.)—The History of the Steam-Engine from the Second Century before the Christian Era. Eew edit., 12mo., boards, 1s. and 1s. 6d. (Cassell.)

WHITE (R. D.) A Catechism on the Marine Steam-engine, containing a few Practical Questious and Answers intended for the use of Young Naval Officers. Post 8vo., pp., 40, cloth, 2s. (Simpkin.)

WILSON (J.)—The Mechanical Inventor's Guide; comprising Familiar Treatises on the the laws of Motion, the Mechanical Powers, and Drums and Belts, and Toothed Wheels, and a collection of nearly 300 Mechanical Movements: forming a Practical Introduction to the Principles and Components of Machinery. 12mo., illustrated by 10 plates of diagrams, pp. 80, cloth, 3s. 6d. (Simpkin.)

NOTES OF EVENTS OCCURING IN THE UNITED STATES.

WE glean the following notes of events interesting to the engineering profession, occuring in the United States, from some of the American papers:—

The *Winans*, cigar steamer, (says the *Baltimore Sun* of August 2nd.) made another trip down the bay on Saturday; as seen from Hawkins' point the vessel appeared to glide smoothly andrapidly, as compared with the other crafts in view.

The *Philadelphia Press*, August 4th and 6th reports a terrible accident which occurred on the Northern Railroad of New York, on the night of the 2nd inst The bridge at Schagticoke over the Tomkannock gave way as the train was passing over it, and the cars were precipitated a distance of 20 or 25 feet into the creek below; thirteen persons are reported as killed and about twenty wounded The coroner's jury have returned a verdict that as the bridge was known to be unsafe the superintendent and directors should be held responsible. The same paper reports that a Locomotive, on the South Carolina Railway, near Angusta, exploded on the 4th inst., killing five persons.

The *Philadelphia Press* of August 6th, states that the great New York aud Erie Railway is at the Bankrupt point; the shares are selling at 5 per cent. A receiver has been appointed.

From the *Philadelphia Ledger*, of June 13th, we learn that the steamboat *John Lawton* exploded her boiler on the evening of the 10th ult., near Savannah. Eight persons were killed and missing. The boat is a total loss. The *Philadelphia Press*, June 23rd, informs us that Winan's experimental *Czar* steamer has sunk at Baltimore, in consequence of a workman neglecting to close a supply pipe. The same paper, of June 29th, states, a terrible accident occurred on the Michigan Southern Railroad, in consequence of a culvert on the line having beeu washed away; a train of cars was thrown off the track, 33 persous were killed, and 50 or 60 wounded. And from the same paper, July 2nd, we extract the following list, which includes the most serious accidents which have befallen railway trains in the last six months:—

		Killed.	Injured.
March 5,	N. Jersey R. R., collision	—	6
April 14,	Miss. Central, bad rail	9	8
„ 14,	Mem. & Chi., bridge broke	2	
„ 23,	Eastern R. R., ditto	1	—
May 17,	N. Y. Cent. obstruction	1	15
June 10,	at Bristol, Tenn.	1	6
„ 4,	Cam. aud Atlantic, obstruction	2	6
„ 15,	Cleveland Pittsburg	—	10
„ 27,	Baltimore and Ohio	1	10
„ 28,	Michagan Southern, embankment caved	34	50
		44	102

Thus far, a much smaller number of lives have been lost this year by accidents of this sort than duriug the year 1858. By the *New York Herald*, of July 6th, we perceive that the steamer *Bay State* burst a sheet in her larboard boiler last evening, just after leaving New York. The engineer, fireman, and a passenger were scalded. In the *Philadelphia Press*, of July 23rd, it is stated that the boiler at the wire-works of J. Washburne and Co., Worcester, Massachussets, exploded on the 22nd, seriously injuring six persons.

The suspension bridge at Niagara Falls, which originally sogged only two or three inches under the weight of a train, now sogs nearly twenty inches. The general impression in the neighbourhood (says the *Philadelphia Press* of August 8th) is that this great work of art will one of these days give way and fall into the river. Visitors now walk over the bridge, instead of crossing in the trains as formerly. This statement has since been flatly denied by Mr. Roebling, the builder of the bridge, who asserts that it is as safe as on the first day that it was opened, and that the apparent increase of the "sogging," is caused by the temperature of the summer weather.

The *Baltimore Sun* August 22nd, says:—Shortly after 3 o'clock on Saturday morning, the freight engine, No. 5, exploded her boiler at the Relay House Station, on the Northern Central Railroad. No one was killed.

The *Philadelphia Press* August 4th, reports that the boiler of a dredging machine, on the Albemarle and Chesapeake Canal exploded near Norfolk on the 23rd inst. Three men were killed.

The *Philadelphia Press*, Aug. 8, reports a terrible boiler explosion, which occurred at the paper mill of Randolph Van Liew and Co., at Bloomsbury, Essex Co., New Jersey, on 5th inst., by which one person was injured fatally, and two others seriously, and the property damaged to the extent of from $2,500 to $3,000

The boiler of a steam mill near Millard, in Falton, county Indiana, called the Germantown Mills, exploded on Wednesday last, killing two men and severely wounding a third. It was a new boiler and was being tried for the first time.—*Philadelphia Ledger*, August 9.

NATURE OF WATER: CONFIGURATION OF VESSELS.—The chief points in the nature of water which influence the configuration of vessels destined for navigation, hinge upon attraction and gravitation in the mass. Its particles appear to cousist of globular molecules, disposed in columns, which balance each other under the same atmospheric pressure at equal distances from the centre of the earth. It is the non-elastic frictionless body, considered with reference to the nature of its own particles, but is capable of exciting the quality of friction when brought in contact with any other body of matter. The cohesion of its particles is very slight, beiug only sufficient to form in bodies as large as a dew-drop, and this property, in combination with the force of gravity, gives rise to the descending tendencies of water, and all fluids follow the same law. But as fluids differ from all other bodies in the absence of attraction or cohesion among their particles, they embrace a peculiar property no less singular and wonderful, aud for the mechanical world no more useful property of matter has yet been discovered; that is, the equilibrium of its columns, or the equal pressure of its particles in every possible direction. The hint that nature has afforded to the modeller of a vessel is, the communication of uniform velocity, whatever the rate may be, through the medium of the displacement to every foot of the yielding fluid. All power from sails or engine which is not uniformly received by the submerged body, from head to stern, is wasted on the defective part, and is not only injurious, but sometimes dangerous to the action of the ship. The laws of mechanics will not tolerate the blunders of defective engineering, no less than the laws of sea-locomotion will repudiate all indifferent attempts at moulding the forms of vessels. Therefore it is, that the proportionate distribution of buoyancy, or displacement, so as to obtain a uniform resistance, and thereby secure a more perfect economy of power, constitutes the great problem of modelling,—a problem of universal application to every class of shipping.—*Commercial Bulletin* [American paper].

NOTICES TO CORRESPONDENTS.

C. D. C.—There are some good works upon the subject you have named, which may be purchased second-hand very cheap; and by addressing Messrs. Spon, Booksellers, Bucklersbury, London, they will forward to you two works out of some three or four mentioned in their catalogue.

Inquirer.—The speed recorded on the trial trip of the *Persia*, Royal Mail Steam Ship, will be found recorded in page 45 and 46 of the Artizan, for 1856; the report of the trial also gives her dimensions, &c., the distance of the run was from the Clock Light to the Bell Buoy, a distance of 203 statute miles (about 175 knots) in ten hours, forty-three minutes; the average speed was taken at nineteen statute miles per hour. As to the *Himalaya*, the particulars concerning her will be found on reference to page 55 of the Artizan, for 1854.

P. (Exeter).—The British Association for the Advancement of Science, will next year meet in Oxford, about the end of June. Never mind the rantings of the individual named by you, no doubt "the Grapes are sour." All scientific institutions, whether it be the Institution of Civil Engineers, the Institution of Architects, the Society of Arts, the Chemical Society, &c., &c., depend for the supply of papers upon men who are either inventors or discoverers, or the employers of the inventions and discoverics of others, and it is not surprising that the inventors or discoverers, whether they have patented their inventions or not, should desire to make them known, and is not the British Association as fitting a place for the announcement and description of recent inventions or discoveries in the various branches of science, as the various societies in London? And, by-the-by, a condemnation of "advertising" or even of "puffing" comes with a very bad grace from the individual in question, than whom, no one is so addicted to the very bad habit of puffing, not only his wares, but also himself upon every occasion, whilst like all such, he holds cheaply, and never fails to express his disregard of, the opinions, or talents of others. It should not be forgotten that "empty tubs are the most noisy."

T.—If the vessel was 10ft. beam instead of 9ft., being very flat and of no great depth, she would, if intended for sailing as well as steaming, be a better boat and require but small additional power to drive her at the same speed. You are advised to apply a 4 feet screw, 7ft. pitch, running about 170 revolutions per minute, with 10 horse-power engines to indicate four times their nominal power. A finer pitch and greater number of revolutions per minute may be preferable.

"Great Eastern."—The daily newspapers have had such ample details supplied to them respecting the recent accident, and the whole affair has become so thoroughly well understood, that it is unnecessary for us to occupy our space with a mere recital of the circumstances connected with the accident, or for an unprofitable discussion as to the cause thereof; but in giving the concluding plates of the series, we shall give *correct* views of the water casing, and of the effects of the collapse and explosion, with *accurate* details and textual explanations connected with the construction, &c. When *the* trial trip takes place, we shall record all that is interesting or useful concerning the ship and her machinery.

Other Correspondents will be replied to by post; and such as are not answered in the present number, from not having favoured us with their addresses, will, upon informing us thereof, receive immediate attention.

Errata.—Notice to our Readers.—In consequence of an accident to the *forms* when about to send the October number of the Artizan to press, several inaccuracies, which had been corrected in the proofs, were, unfortunately, allowed to pass unnoticed in the hurry of making good the delay caused by the accident, and although they are unusually numerous in the second and third sheets, they are all of a character easily to be recognised and corrected; but we may direct attention more especially to the paper of Mr. Atherton, pp. 252—254, in which the formulæ $\frac{V^3 D^{\frac{2}{3}}}{\text{ind. h. p}}$ and with $\frac{V^3 D^{\frac{2}{3}}}{\text{ind. h. p.}}$ as also $\frac{V^3 D^{\frac{2}{3}}}{w}$ (*w* being the consumption of coals per hour expressed in cwts.) In each case the V^3 was mistaken by the compositor for $\sqrt{}^3$ There are other minor errors which will be readily detected, and do not require special notice.

NOTICE.

The continuation of the papers "Steam Engineering in 1859," cannot be given until next month, when sufficient space will, we hope, be reserved to enable them to be concluded in that number.

DEATH OF ROBERT STEPHENSON, ESQ., C.E., AND M.P.

This month we have to record the loss of another of our great Civil Engineers —Robert Stephenson, M.P. for Whitby, F.R.S., and F.G.S., who expired on the 12th October ult., at his town mansion, 34, Gloucester Square, Hyde Park. For the boldness, vastness, and originality of some of his successfully executed projects, the name of Robert Stephenson may be pronounced to stand unrivalled in the annals of Engineering skill.

As a Railway Engineer, his name is inseparably connected with the "Planet" Locomotive, of which, while yet in early yonth, he was the original designer: and which, with its multitubular boiler, with cylinders in the smoke-box, with the crank-axles, and external frame-work, forms, in spite of some modifications, the type of the Locomotive Engines exployed up to the present day. His next great work was the survey and construction of the London and Birmingham Railway, the first sod of which was cut on the 1st of June, 1835, and the line opened in 1838. In the construction of Tunnels and Railway Bridges, his engineering skill was conspiciously displayed, as evidenced in the great Kilsby Tunnel, the High-level Bridge at Newcastle, constructed of wood and iron; the Victoria Bridge at Berwick, of stone and brick; the bridge in wrought and cast-iron across the Nile; the Conway and Britannia Bridges, over the Menai Straits; the Viaduct over Tweed Valley, at Berwick (supposed to be the largest in the world); and the great Victoria Bridge, over the St. Lawrence, his latest and perhaps most important work, and the approaching inauguration of which he has not lived to see. On questions of what we may term controversial engineering warfare, he was an ardent and powerful, if not always a successful partizan, even when, as in the much vexed questions of the comparative merits of Stationary or Locomotive power on lines, the claim for superiority between the Broad and Narrow Guages (familiarly known as "the Battle of the Guages"); and the feasibility of the great Suez Ship Canal Scheme, he found himself in direct antagonism with such minds as the late Mr. Brunel; and, in the latter instance, at issue with the leading engineering celebrities of Europe.

The whole of the newspaper press of the country has so fully entered upon the many and great works of professional and private worth of this great and much to be lamented man, that it is needless for us to detail his many and glorious acts, amongst which his unbounded and well-directed acts of benevoleuce are not by any means the least deserving of note.

As a mark of the high estimation in which he was held by the British Public, a place of sepulture has been assigned him in Westminster Abbey; where, on the 21st October ult. his remains were interred in proximity with those of the late eminent engineer Thomas Telford.

AMERICAN NOTES FOR 1859, No. 5

DIMENSIONS OF STEAMERS.

Steamer "De Soto."

Built by Messrs. Lawrence and Foulkes; engines by The Morgan Iron Works.

DIMENSIONS.

	Ft. 10ths.
Length on deck	252 0
Breadth of beam	38 8
Breadth of hold at beam	19 2
Depth of hold to spar deck	26 8
	Tons.
Tonnage	1600

Fitted with a vertical beam engine; return-flued boilers; diameter of cylinder, 65in.; length of stroke, 11ft.; diameter of paddle-wheels over boards, 30ft.; length of boards, 9ft., depth, 1ft. 6in., No., 26; No. of boilers, 2, length, 27ft., breadth, 12ft., height, exclusive of steam chests, 10ft.; No. of furnaces, 6, breadth, 38in. and 44in.; length of fire bars, 7ft. 6in.; No. of flues, 36, internal diameter, 8in., 10in., 11in., 12in., 13in., and 16in., length, 13ft. 3in. and 19ft. 6in.; diameter of chimney, 6ft. 6in., height, 32ft.; area of immersed section at load draft, 530ft.; load on safety valve in lbs. per square inch, 20 lbs.; date of trial August, 1859; draft forward, 15ft., aft, 15ft.; maximum revolutions, 18; frames, 16in. × 19in., and 28in. apart; 1 bulk-head; depth of keel, 10in.; 1 independent steam, fire and bilge pump.

DESCRIPTION.

Two masts; brig rig; intended service, New York to New Orleans.

Steamer "R. R. Cuyler."

Built by Samuel Sneden; engines by The Allaire Works.

DIMENSIONS.

	Ft. 10ths.
Length on deck	235 0
Breadth of beam	32 0
Depth of hold at beam	17 6
Depth of hold to spar deck	23 3
Length of engine space	66 0
	Tons.
Tonnage	1600

Fitted with a vertical direct engine; horizontal tubular boilers; diameter of cylinder, 70in.; length of stroke, 4ft.; diameter of screw, 16ft., length, 4ft. 9½in., pitch, 22ft. 6in., No. of blades, 4; No. of boilers, 2, length, 17ft. 4in., breadth, 13ft. 6in., height, exclusive of steam chests, 13ft. 9in.; No. of furnaces, 6, breadth, 3ft. 11in.; length of fire bars, 7ft. 6in.; No. of tubes, 288, internal diameter, 4in., length, 14ft.; diameter of chimney, 4ft. 4in., height, 21ft.; area of immersed section at load draft, 548ft.; heating surface, 6258ft.; contents of bunkers in tons, 150; consumption of coals per hour, 71 tons; date of trial, October, 1859; draft forward, 16ft. 6in., aft, 18ft.; average revolutions, 36; frames, 14in. × 10in. and 12in. × 24in. apart; depth of keel, 12in.; 1 independent steam, fire, and bilge pump.

DESCRIPTION.

Two masts; foretopsail schooner rig; intended service, New York to Havannah.

Steam Frigate "General Admiral."

Built by William H. Webb; engines by The Novelty Iron Works.

	Ft. 10ths.
Length on deck	308 6
Breadth of beam	54 6
Depth of hold at berth deck	18 3
Depth of hold to spar deck	33 7
Length of engine and boiler space	104 0
	Tons.
Tonnage	$4,306\frac{92}{95}$

Fitted with horizontal back-action engines; horizontal tubular boilers; diameter of cylinders, 2 of 84in.; length of stroke, 3ft. 9in.; diameter of screw, 19ft.; length, 7ft., pitch, 31ft.; No. of blades, 2; No. of boilers, 6, length, 19ft. and 22ft., breadth, 10ft. 3in., height, exclusive of steam chests, 12ft. 6in.; No. of furnaces, 38, breadth, 2ft. 7in.; length of fire bars, 7ft. 6in.; No. of tubes, 2,760, internal diameter, 3in., length, 7ft.; internal diameter of chimney, 11ft., height, 65ft.; area of immersed section at load draft, 836ft.; load on safety valve in lbs. per square inch, 20; heating surface, 21,000 square feet; contents of bunkers in tons, 650; consumption of coals per hour, maximum, 4 tons; date of trial, May, 1859; draft forward, 22ft., aft, 22ft., at load line, 23ft. 6in.; revolutions at 22ft. draft, 52; weight of engines 175 tons, boilers, without water, 250 tons; frames, 22in. × 16in., and 38in. apart at centres; independent steam, fire, and bilge pumps, 1.

DESCRIPTION.

Three masts; rig, ship; intended service, Russian Imperial Navy; gearing, direct; point of cutting off, half stroke.

REMARKS.

This vessel is very fast, both under canvass and steam, and manœuvres with great rapidity for one of such dimensions. In her passage out, she ran from New York to Cherbourg in 11 days and 10 hours, part of the way under canvass alone, when she overhauled and passed an American clipper ship. In one day she steamed 307 knots.

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c.

Under this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least —less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.

A New Colliery Inspection Act is in preparation by the Government, the present one, (that of 18 and 19 Victoria c. 108) expiring in 1860. The Home Secretary has accordingly forwarded a circular to the Inspectors appointed under the latter Act, requesting suggestions for an amendment of the Law as it now stands, with reference to any sanitary measures, regulations for the prevention of accidents, or mechanical improvements, which may, with advantage, be embodied in the new Act, (the operation of which it is in contemplation to extend to Iron-stone mines): as likewise, suggestions as to the means of remedying the injustice done to the men, by the methods at present employed for ascertaining the weight of the material at the mouth of the Pit.

Working Below Ground (by boys under 10 years of age) is strictly prohibited by the provisions of the Act 5 and 6 Victoria, c. 99.

The Loss of the "Alma" Steamer, wrecked on a Reef, in the Red Sea, 12th of June ult.—The Board of Trade Inquiry into the circumstances of this disaster was opened on the 5th October ult., at the Greenwich Police Court, before Governor Traill. The *Alma* left Calcutta for Suez on the 18th of May ult. The crew consisted of Lascars. The Captain being ill the command of the ship, on leaving Aden, was intrusted to the Chief Officer; from whose examination it appeared at 2.55 a.m. whilst steering N. ½ W. at full speed, and just before the ship struck, he found that by some mistake of the bearings, she was nearing the Musharajeh Reef, which looked like a shadow on the water across the ship's bows, from the Westward. Gave no orders to reverse the engines, only to stop them. The head of the ship was N.N.E. when she struck. The Red Sea Pilot (who, it appears, is about 70 years old, scarcely able to walk; and who, in addition to having almost lost his eye-sight, has been on board nearly every steamer that has gone on shore in the Red Sea) made no communication to witness. Proceedings adjourned to the 10th October ult., when the inquiry closed; Mr. Traill expressing the opinion of the Court, that Mr. Davis, the Chief Officer, was in charge of the ship, and that in altering the course at 12.45, if he had consulted the Chart, he would have found that the course was not altered sufficiently, but that the vessel was nearly in a direct course to run on to the rocks where she became a wreck.

The Locomotive Explosion on the Lewes Railway.—The Coroner's jury, 7th October ult., found "that the explosion was caused by an excess of steam pressure beyond that to which the steam valve was screwed down, but there was no evidence to show how such increased pressure was obtained. The jury recommended that every Locomotive engine should be provided with a locked-up safety-valve beyond the control of the driver, in addition to the valves now in use; and that some regulation should be prescribed for ascertaining, with more exactness than at present, the weight to be taken by engines on railway goods' trains."

Prepayment for Gas.—In the Westminister County Court, 27th September last, it was decided that the Gas Companies have a right to cut off their gas, if they please, or to refuse continuing the supply in cases, where, at the original arrangement, it has been stipulated that the consumer shall pay a sum in advance; although such sum has been formally paid, under protest, the Company continuing to supply the gas until the sum in hand was exhausted; and then threatening to cut off the supply unless the deposit in advance was renewed. In the present case the Equitable Gas Company, had, under circumstances similar to the above, proceeded to open the street in front of the consumer's house, to cut off the gas, whereupon the money (in renewal of the original deposit) was paid under protest, and the gas supplied as usual. The consumer, thinking the company was not justified in acting as they had done, brought the present action (for damages sustained through the proceedings of the servants of the company, in opening up the street in the front of the house, and thereby obstructing the footpath) to try the point. The judge held that the Gas Consolidated Act expressly gives to the Gas Companies the power that had been exercised on the present occasion. They went on supplying the gas until there was no deposit, and they could, if they pleased, refuse to continue to supply, unless their terms were agreed to. Plantiff, accordingly, nonsuited.

The Fatal [Steam Threshing Machine] Explosion at Lewes.—The inquest held at Lewis, after repeated adjournments, returned (2nd October ult.) a verdict "that the deaths were occasioned by the explosion of a steam engine boiler, caused by the non-action of a safety-valve: and that the said engine, from subsequent examination, has been found to be of inferior quality and construction, and not properly prepared and examined before it was used. The jury feel it their duty to recommend that every portable steam engine should have an indicating pressure-guage; and that the present system of employing unskilled persons as engineers requires that all persons so employed should be properly examined and certificated, and that a periodical inspection of such engines should be made by competent persons.

A Masters' "Lock-out" as Affecting Wages.—At the Clerkenwell County Court, 11th October ult., a working-mason sued his employer, a master builder, for £2, being one weeks' wages in lieu of notice; plaintiff being "locked out" on the 8th August last. The defence attempted was that it was not customary to give a week's notice: and, further that the plaintiff was only in the position of 10,000 masons, who were locked-out at the same time. The judge said, "I have nothing to do with that. There is no reason why the plaintiff should suffer for the deeds of others. I have no doubt the plaintiff is entitled to his claim, he is clearly entitled to a verdict for the full amount claimed, with costs."

Compensation for Railway Accidents.—"Settling" Agents.—At the recent Warwick Assizes (Midland Circuit), in the case of Farmer *v.* the London and North Western Railway Company, plaintiff, who is a steel roller in the employ of a firm of edge-tool manufacturers, at Birmingham, was a passenger in an excursion train from Birmingham to Chester, on 5th May, 1858, and, by a collision that took place, near Slitford, had sustained, as alleged, serious injury. Defendants pleaded that they had paid, and that plaintiff had accepted, the sum of £2 10s. as compensation for the injury. Plaintiff replied, and took issue upon the plea that he was induced to take that sum by fraud, and never intended it to cover all consequences that were likely to ensue. The fraud here alleged was based on the fact of the medical agent of the Company having "in a most friendly and coaxing way," as described by plaintiff's counsel, induced the plaintiff to accept of the small sum in question, by his assurance that the injury sustained (a hurt to the knee) was of no consequence, and would be well in a few days; whereas the knee subsequently grew worse, and at length, so seriously affected as to incapacitate him from following the ordinary duties of his employment. The plaintiff's counsel, in the course of his pleading, made some severe remarks on the alleged practice of railway companies, in like instances, sending out their "missionaries" to "settle" with the injured persons, adding that he was very sorry to think that the medical profession should level themselves to any such thing. To these observations, however, Mr. Justice Erle expressed his unwillingness to listen, inasmuch as such matters were for the decision of other tribunals than a law court, and that it would be better not to import such imputations into the case. Ultimately, the jury returned a verdict for the defendants (the Company), whose counsel, after the verdict had been returned, said, he was instructed to say, that notwithstanding this verdict, the plaintiff's case would be considered, and he would receive compensation for the injuries received, after investigation.

The Fatal Collision on the Lyons and Paris Railway, on 1st August ult. causing the death of three persons, and wounding thirty-three more or less dangerously, has been the subject of judicial investigation. The result has been the condemnation of the chef-de-gare to two years imprisonment, one of the assistants to one year's imprisonment, and a third to six months. All of them were fined 300 francs, and held liable to the costs, the Company being held civilly responsible for the results of the dreadful accident. A Madame Munier was killed; her husband sued the Company, and has recovered 30,000 francs damages—a wholesome warning to all careless railway employés in France.

For Wilfully Damaging a Drinking-Fountain, in the Great Western-road, Kensington, a man was, recently, at Hammersmith Police-court, sentenced by the magistrate to pay a fine of 40s., or in default a month's imprisonment. Locked up in default.

The Smoke Nuisance Act.—Steam Navigation on the Thames.—At the Thames Police-court the master of the steam-tug *Tam o'Shanter*, belonging to the Caledonian Steam Towing Company, was, recently, summoned before Mr. Selfe, upon an information charging him with "the unlawful use in the working of the said steam-vessel, on the river Thames, of a certain steam-furnace not constructed so as to burn or consume its own smoke." The summons had been taken out by the superintendent of the Thames police, by direction of the Secretary of State, under an amended Act, 19 and 20 Vict. cap. 107 (passed in July, 1856), which enacts, "that all steam-vessels plying to and fro between London-bridge, and any place on the river Thames westward of the Nore Light, shall be subjected to the provisions of the Smoke Nuisance Abatement Act relating to steam vessels above London-bridge. The defence was, in substance, that the *Tam o'Shanter* was simply a steam-tug or steam-towing vessel, that she was used for no other purpose, and that she did not ordinarily ply to and fro between London-bridge and any place on the river Thames to the westward of the Nore-Light, consequently that she did not come within the reasonable meaning of the Act, which it was contended by defendant's legal adviser was only intended to be applied to steamers ordinarily engaged in the passenger traffic exclusively; and that if towing vessels in the practice (like the *Tam o'Shanter*) of going to sea, were compelled to apply apparatus to their furnaces to consume or burn their smoke, thereby decreasing the power, as it was asserted, of their marine-engines, and lessening their speed, then the Rotterdam steamers, the Irish and Scotch steamers, and the fleet of the General Steam Navigation Company must all come within the operation of the Act, and the expense and trouble would be incalculable; and that it was never intended to apply the Smoke-consuming Act to towing-vessels which proceeded eastward to the Nore. In the course of the evidence it transpired that there had already been twelve convictions under the amended Act, as regards vessels plying between London-bridge and the Nore, viz., in the case of the *Victoria*, a passenger-boat, and the *Magnet*, a towing-vessel, but that the present question was never raised before in that Court. Mr. Selfe admitted the great importance of the case, and thought the question raised ought to be settled by a higher tribunal. To this end, as being the most convenient course, he would convict, and then a case could be stated for the Court of Queen's Bench. As to a remark made by defendant's counsel that the steam-tug was only used for commercial purposes, there was nothing in that, because the Smoke-Nuisance Act for factories on land, related only to the furnaces of manufacturers, sugar-refiners, alkali-works, glass-works, chemical works, and other trades, and was not applicable to private houses at all. His own impression was, that the Act did apply to a ship circumstanced like the *Tam o'Shanter*. The object of the legislature was to purify the Thames, and prevent the people living in houses, cottages, and farms from the annoyance of dense volumes of smoke continually issuing from the funnels of the numerous steamers navigating the stream. There was no question about the facts of the case, and he should formally convict the defendant in the nominal penalty of 5s.; which being done, it was agreed that Mr. Selfe should state a case for the opinion of the court of Queen's Bench.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

We have received many letters from Correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this, would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed, "19, Salisbury-street, Adelphi, London, W.C.," and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

The long-doubtful Fate of H. M. Ships "Erebus" and "Terror" (Sir John Franklin's Arctic expedition) has been at length ascertained. They were abandoned on April 22nd, 1848, in the ice, five leagues to the N.N.W.; and the survivors, in all amounting to 105 souls, proceeded to the Great Fish River, Sir John Franklin himself having died on June 11, 1847. These facts are stated by Captain McClinlock in a communication to the Secretary of the Admiralty (since officially published), and on the authority of a record, dated April 25th, 1848, and signed by Captains Crozier and Fitzjames, at Point Victory, upon the N.W. coast of King Williams' Island. Subsequently to their abandonment, one ship was crushed and sunk by the ice, and the other forced on shore, where she has ever since remained. These highly-interesting details have been furnished by the arrival (21st September ult., off the Isle of Wight) of the *Fox* screw discovery vessel, Captain M'Clintock, which was sent to the Arctic regions, at the expense of Lady Franklin, to discover traces of the missing expedition.

Comparative Exports from London, Liverpool, Hull, and Bristol.—The declared value of British and Irish produce and manufactures exported from the 12 principal Ports of the United Kingdom, during the year 1848 (official Parliamentary Return just published) amounted to £104,695,864. Towards this enormous sum, London contributed £28,886,839: Liverpool £50,899,668: Hull £13,449,733: whilst Bristol contributes only £538,418, part of the exports of the remaining 9 "principal ports"—viz. Bristol, Newcastle, Southampton, Leith, Glasgow, Greenock, Dublin, Cork, and Belfast; which, together, make up the balance of £11,459,624: whence, it appears, that Hull may now claim to be the third in importance of the ports of the United Kingdom, instead of ranking as the fourth merely, in the hitherto unquestioned formula of our old school Geographies —"London, Liverpool, Bristol, and Hull."

THE NEW EXMOUTH LIFE-BOAT, presented to the town by Lady Rolle, was launched recently, having on board her Ladyship and other persons of distinction. Trial perfectly satisfactory. This Life-Boat (by Forrest) is 30 feet long, by 6½ broad, and is built after the "Institution" model.

THE CORK LIFE-BELT, which each of the Crew of a Royal National Institution Boat is now always required to wear before going afloat in the Life-boat, was also successfully experimented with, on the above occasion.

TWO POWERFUL DREDGING-MACHINES have been fitted out at Portsmouth Dockyard for service at Malta, whither they will shortly proceed.

AN IMPROVED BOYDELL'S TRACTION ENGINE FOR EGYPT, was received, recently, at the Royal Carriage Department, Woolwich, from the manufacturers at Thetford, to be forwarded to Cairo for the Egyptian Government. The new Engine is built on an improved principle, and has come out under an entirely novel exterior. The huge, ungainly looking "slippers" forming the endless Railway, which formerly gave the Engine so ponderous an appearance, are now hidden under a light and neat-looking casing, similar to the paddle-wheel boxes of a small lake steam-boat.

THE MANCHESTER COUNTERPANE WEAVERS, having demanded an advance of wages, upwards of 20 firms have closed their weaving-shops against the operatives, and no further waft or warps are to be supplied (by the masters) to the weavers, until the propositions of the men shall have been withdrawn. This is in pursuance of a resolution passed at a recent meeting of the masters.

A NEW PNEUMATIC FIRE ALARUM has been introduced. It consists of an enclosed screw-gearing arrangement, with a dial-plate marked with figures indicating temperature to a given degree, to which the single hand on the dial-plate is set. If the temperature around the machine be raised above that degree, a catch is disengaged, a weight is released, and a bell or alarum rings. This alarum is set in action by a regulated lever, within the machine (which in form somewhat resembles a "bottle-jack)," at the lower end of whose hollow body is a cylinder of metal, with a metal bottom, and a sheet of Caoutchouc at top; the cylinders in fact, being a sort of flat bottomed kettle-drum, perfectly air tight, but filled with atmospheric air. As the temperature increases, the enclosed air expands; the caoutchouc top rises upwards in a convex form, until it presses against the spring communicating with the catch, the consequent withdrawal of which sets the alarum free.

THE NEW "GREAT ISAAC'S LIGHTHOUSE" [or "Victoria Light"] recently completed and lighted for the first time, at the Northern extremity of the Great Bahama Bank, New Providence, is a circular tower raised on a barren rock, and is formed of 255 cast-iron plates, varying in weight from 3 tons to 30 cwt. Extreme height from the ground to top of vane, 144 feet; and at the level of the floor of the lantern, where it has a diameter of 12½ feet, it is surrounded by a galley guarded by a strong iron-railing, and supported on ornamental brackets, forming the capital of the column. In the centre of the tower is a large cast-iron pipe, 2 feet in diameter, and 1 inch in thickness, extending from the base to the summit, serving for support of the floors, and frame for the catoptric reflectors; and serving as a case for the clock-weight to work in; a door placed at the foot, giving access in case of repairs being required. The tower is ascended by means of a spiral staircase, which runs round the exterior of the base to the height of 24 feet. The lantern (with 16 faces or sides) is placed on the summit of the centre column or pipe. Its base is of cast-iron, uprights, and sashbars of gun-metal, forming a frame for 48 large panes of plate-glass, ½ an inch in thickness; the whole covered in by a roof of copper-plates lined with corrugated sheet-iron. Lighting apparatus of the catoptric order, and revolving 21 parabolic silver plated reflectors, throw back the light from an equal number of argand lamps for burning Colza or Rapeseed oil; the frame is put in motion by clockwork, made of gun-metal and steel enclosed in a copper case; the weight being suspended by a strong cat-gut line, winding round a barrel; the velocity being regulated by a governor. Constructed for the Lords of the admiralty, by H. and M. D. Grissell, Regent's Canal Iron-works, London.

THE SMOKE NUISANCE.—At a recent meeting of the Barnsley Board of Health, some interesting facts relating to the possibility of remedying this grievance, which, by a deputation of the inhabitants of Barnsley, was described as becoming intolerable, were brought to notice. In one large manufactory at Bradford, in which 3,000 hands are employed, the smoke is now consumed so effectually, that the chimney does not emit more than issued from an ordinary house fire. In Birmingham the smoke nuisance has been abated to such a degree, that 180 chimneys which now exist, do not send forth more smoke than 70 formerly did. At the extensive works at Saltaire, the smoke from 28 furnaces is almost imperceptible. At Mr. Sykes's Bleach-works, apparatus has been erected for the burning of smoke, with such success, that although there are 3 boilers to feed, they have only the smallest possible quantity of smoke. In Huddersfield, exertions are making to abate the nuisance; whilst in Barnsley there are still (in spite of repeated notices issued by the local Board of Health, calling upon parties to burn the smoke they make)—a host of chimneys which send forth vast quantities of smoke. With regard to apparatus similar to that of Mr. Sykes, (above alluded to) it can be erected at a cost of £1 per horse power for new boilers; and £3 for old boilers; whilst the saving in coal is very considerable. The Board resolved again to serve all the offending parties with notice.

THE "WRECK REGISTER AND CHART FOR 1858" presented to Parliament, by the Board of Trade, contains the following statement of the number and character of the shipwrecks that have occurred in the seas, and on the coast of the British Isles, during the past 7 years:—

Wrecks and Casualties in	Wrecks.	Collisions.	Total Wrecks.	Total Lives lost.
1852	958	57	1,015	920
1853	759	73	832	689
1854	893	94	987	1,549
1855	894	247	1,141	469
1856	837	316	1,153	521
1857	866	277	1,143	532
1858	869	301	1,170	340
Total	6,076	1,365	7,441	5,020

In 1858, 1,555 lives were rescued, by life-boats, other boats and ships; and by the Rocket and Mortar apparatus.

SUMMARY OF NUMBER AND LOCALITY of the wrecks on the British shores, during the past year.

	Vessels.
East Coast—Dungeness to Pentland Frith	514
West Coast—Land's End to Greenock	304
South Coast—Land's End to Dungeness	89
Irish Coast	168
Scilly Islands	14
Lundy Island	15
Isle of Man	6
Northern Isles, Orkney, &c., &c.	60
	1,170

THE LOOMERS, TWISTERS, DRAWERS AND BEAMERS in several of the Blackburn Cotton Mills, have struck for an advance of wages. This demand has been hitherto resisted by resolution of the Blackburn Spinners and Manufacturers' Association.

THE EXPORTS OF MACHINERY [Steam Engines] in the month of August last, were declared value of £158,330, against in August 1858, £46,513 only: Ditto of other sorts, £252,383 against (in August 1858) £210,037.

THREE "WATER-POWER CHURNING MACHINES" have been erected in Druncoon, Ireland; and a fourth is in progress.

OF MORTAR AND ROCKET STATIONS on our coasts, (for affording aid in shipwreck) there are 216, chiefly under the control of the Board of Trade.

OF LIFE-BOATS, (for the like purpose) there are now 149 on the coast: 82 of which are under the management of the Life boat Institution; and 67 belong to local authorities. Each (Institution) Boat has a paid Coxswain, and a volunteer crew attached to her, who are promptly paid, after they have been afloat in the boats.

"CLOSING" MACHINES.—The Shoemakers of Drogheda, in Ireland, have recently struck, in consequence of the Employers using one of these Machines. This town is remarkable for its manufacture of shoes and boots.

OF BRITISH AND IRISH PRODUCE AND MANUFACTURES (Board of Trade Returns), the total declared value of the exports in the month of August last, was £12,117,275, against corresponding month in preceding year, (1858) £11,134,763.

OF HARDWARES AND CUTLERY the exports were, for same period, £303,287, against, in August 1158, £272,017; showing an increase.

RAILWAYS.

AMERICAN [HORSE-TRACTION] RAILWAYS.—In the city of Boston alone the following is the daily return of the journeys by horse-traction on the local railways:—

	Journeys.	
Roxbury	113	To and fro daily.
Mount Pleasant	45	
Warren Street	44	
Boston Neck	171	
West Roxbury	30	
Tremont Street	70	
	473 Journeys.	

Or 946 journeys, making about . . . . . . 5,000 miles per day.

FROM CAPE-TOWN TO THE SUBURBAN DISTRICTS of Mowbray, Claremont, and Wynberg a railway, 8 miles in extent, is to be constructed by a Company, 3,000 of the shares in which have already been taken, out of 5,000.

RUSSIAN LINES.—On the St. Petersburg and Warsaw Railway, 20,000 men are at work; and other lines are progressing.

BETWEEN MOSCOW AND SARATOV the construction of a railway of 700 versts has been authorised. The capital to be 45,000,000 rubles, in 450,000 shares, of 100 rubles each, with a government guarantee for 80 years, at 4½ per cent.

INDIAN LINES.—The first obligatory line of the Oude Railway, that between Lucknow and Cawnpore (late advices to June ult.) is to be commenced upon about the close of the rains. The line has been already surveyed, estimated for, and determined.

BETWEEN LUCKNOW AND FYZABAD is the line next determined upon; and will, possibly, be commenced simultaneously with the Cawnpore line.

CANADIAN LINES.—The Northern of Canada (late the Ontario, Simcoe, and Huron) Railway Company have, recently, held a meeting of bondholders in London, to adopt measures in relation to certain legislative enactments of the Canadian Government, at present the virtual owners of the whole property of the railroad, through default of the original company. A recent order in council, based on certain proposed conditions, now offers great prospective advantages to the bondholders; the principal of these conditions are the registration of the bonds, and the raising of £250,000 of new capital, on perfecting which, the Canadian Government propose to retransfer the power of management of the line to the present bondholders. The meeting adopted the recommendation of the Committee to appoint a standing committee, to be entrusted with the government of this property until the registration was completed, with power to carry out the arrangement with the official representatives of Toronto and the Government. By the new arrangement, the vice-president assured the meeting that the line (hitherto not flourishing) would be restored, and placed in as good a condition as the Grand Trunk, "which stood higher than any other railway in America"—that they would have a solid stone structure, iron girders and bridges, and a perfect and efficient rolling-stock for the line, which would then be placed in a thoroughly efficient condition.

THE CHARING-CROSS RAILWAY, it is officially stated, will be constructed at a cost of not more than £1,000,000, including the purchase of the required property, the building of the bridge over the Thames, and the erection of the necessary stations. Of this sum, the South-Eastern Railway Company, at their meeting held 1st September last, agreed to subscribe £300,000, guaranteeing 4½ per cent. upon the amount of the shares. In the estimates, recently submitted to the Secretary of the Committees of both Houses of Parliament, £14 per square yard was set down as the value of the property to be purchased, being £6 more than that estimated for the purchase of property required for making the new street in Southwark by the Metropolitan Board of Works. The Hungerford Market property was bought, provisionally, before the Bill was passed, and the amount was included in the estimates.

"WEAR AND TEAR" ON RAILWAYS.—20,000 tons of iron require to be replaced every year on Railways, owing to "wear and tear," and 26 million wooden sleepers require to be replaced annually from the same cause. 300,000 trees are annually felled to make good the decay of the sleepers, and this number of trees require for their growth, 5,000 acres of Forest land.

IN NEW ZEALAND the contract for the first Railway—namely, from Christchurch to Littleton, has been made.

DUTCH LINES.—The Minister of Finance has recently presented to the Chambers an item in the Budget for 1860, providing for a subsidy of 28,520,000 florins (£2,376,000 sterling) to be paid in instalments during six years, in promoting the system of Railways in Holland, involving an anticipated loss during that period, of 5,277,800 florins (£440,000) by guarantee of interest.

FOR THE RAILWAY TO VARNA AND RUSTSCHUK, the concession has been (advices from Constantinople to 17th September ult.) granted to the Turkish Consul at Antwerp.

SARDINIAN LINES.—The portion which joins Stradella with Castel-San-Giovanni is nearly finished; thus expediting the completion of the junction with the line from Plaisance to Bologna.

THE RATE FOR CARRIAGE of goods on the Grand Trunk Canada Railway, is ⅝d. per ton per mile. The line has substantial bridges and gradients over which an engine can draw 200 tons of goods; and its haulage is 700 miles, without a transhipment; a goods' traffic capability of which but few existing railway lines can boast.

THE FRENCH RAILWAYS, for which concessions have been granted form an aggregate distance of more than 16,000 Kilometres.

THE NEW BRANCH of the Eastern of France Railway to Vincennes and Varenne Saint Maur, was opened to the public on the 22nd September ult. The extremely low fare on this new branch line (3 sous) is calculated for the accommodation of workmen living in the suburbs, whose occupations may call them to Paris.

ITALIAN LINES. FROM SIENNA TOWARDS ROME, the line has been finished as far as the Tuscan Frontier extends, but it stops at the first Papal village, Asina Lunga.

THE MORTARA AND VIGEVANO RAILWAY is proposed to be continued from Vigevano to Milan.

The Tuscan Government has recently authorised the formation of a Company, entitled "the United Tuscan Railway Company," for the completion and working of the Leopold, Lucca, and Pisa Lines, and that of Lucca to Pistoja.

Railway Passes over the Alps.—That over the Simplon, sometime since conceded to the Railway Company, by the Sardinian Government is now likely to be formed, following the example of the Railway which passes over Mont-Cenis.

The Simplon Tunnel is to be eight or nine Kilometres according as the height above the sea, be fixed at 1,200 or 1,250 metres. This will be 400 or 450 metres above the last Station of the Railway in the plains. To attain that height, the line is reported to consist of practicable curves with gradients not exceeding 1 in 28·6. On the completion of this proposed undertaking, the Alps that formerly took twelve hours to pass, will be passed over in half an hour. In that short time the traveller will pass from the valley of the Rhone to the valley d'Ossola; and the Lake of Geneva will be only four hours' journey from the Lago Maggiore.

The Annual distance performed by the Locomotives, on the whole globe, according to some recently published statistical details respecting Railways in India, is 884,700,000 Kilometres (⅝ths of a mile each), or 22,119 times round the globe; and in a few years it will be 2,293,145,000 Kilometres, or 57,329 times round the earth, 6,882 times the distance from the earth to the moon and 15 times that from the earth to the sea.

RAILWAY ACCIDENTS.

Defective Driving Rods.—Whilst the Mail train was, recently, travelling to Shrewsbury, on the joint line of the Shropshire Union Railway, near the Walcot Station, the driving-rod of the engine broke down, causing damage to the Locomotive, and bringing the train to a dead stand. No person injured.

Mounting Trains in Motion.—A stoker employed with a Pilot-Engine in the yard at the Paddington Terminus of the Great Western Railway, was getting upon the Engine whilst in motion, when he slipped and fell to the ground, with his legs between the wheels, the next moment the wheels passed over his legs, almost severing them from his body. He died subsequently in St. Mary's Hospital. At the inquest, the coroner commented upon the number of fatal accidents arising to Railway servants through their own carelessness, such for instance, as getting upon an engine or Train while in motion; and he urged that fines should be inflicted for such acts of carelessness. He hoped fining would become general in all locomotive departments, to prevent in future such fatal occurences. Verdict "Accidental Death."

Obstructions on Lines.—A fatal accident occurred 1st October ult. at Lewes, to one of several men who were at work by the side of the railway. An engine coming along knocked over a large load of bricks which falling upon the workman's head, so injured him that he shortly afterwards expired in Guy's Hospital.

Level Crossings.—On the Union Line of the Eastern Counties Railway, near the Ardleigh Station, (morning of the 1st October ult.,) two gentlemen were passing the level crossing at this spot, when one of them was killed, being struck by the buffer of an engine of the up-train, and hurled a distance of 40 yards, the engine again striking his body and the wheels passing over and severing both legs. The other had a narrow escape; the engine tearing a portion of his coat away.

Failure of Engine-Wheels.—On the Midland Railway, near the Little Eaton Junction, three miles from Derby, (1st October ult.) one of the wheels of the engine of the Government train from Leeds to London, failed and ran nearly a quarter of a mile off the metal and directly afterwards the other wheel of the same axle dropped of. The engine ran off the line and turned over into a ditch, taking with it the tender, and slightly damaging the first break van. Beyond this, and the tearing up the rails for a considerable distance, no material damage ensued; the driver remaining firm at his post.

TELEGRAPH ENGINEERING.

A Telegraph to India and China, by filling up the existing gap between Calcutta and Rangoon, and taking a new point of departure at the Burmese port, is under consideration. At present, Telegraphic communication is complete between London and Constantinople, at which point there is a stoppage. Another line, however, commences at Alexandria, and is continued along the Red Sea, to Aden, where that also stops. From Kurrachee on the Indian Coast, at the mouths of the Indus, telegraph lines have been carried with only an inconsiderable break, straight across Hindostan to Calcutta, and from there to Rangoon, at the mouths of the Irrawaddy. The Indian line therefore is already perfect, save for two interruptions, one between Constantinople and Alexandria, and the other between Kurrachee and Aden. Both the missing links will be shortly supplied, by connecting Constantinople with Alexandria. In order to reach Hong-Kong, so as to establish communications with our settlement in the Chinese waters, the gap between Calcutta and Rangoon being filled up—a work easily practicable—a new point of departure will be taken at the Burmese Port. From Rangoon to Singapore, the distance is about 1,100 miles, and Singapore is but four or five days from Hong-Kong. A Submarine Line with Rangoon will bring the Chinese territory within a very few days of London. The depth of water between Rangoon and Singapore is slight; and the submergence of the cable need nowhere exceed 50 fathoms. Two Cables of 550 miles each, will suffice for the work. The branch, besides proximity to China, will also form an important link in the line to Australia.

The Gibraltar Cable.—Government have contracted with the Gutta Percha Company for a Cable to be laid from Falmouth to Gibraltar, 1,200 miles, to be ready in June next.

From Gibraltar to Malta and Alexandria, a similar Cable (says the *China Telegraph*) is ordered, thus giving an independent line, free from Continental difficulties.

The Alexandria to Constantinople Cable, it is now settled, is to be laid through the Islands of Rhodes and Schias to Constantinople, and not by way of Candia, as previously intended.

Between Chios and Smyrna, by advices from Constantinople to 17th September ult. the Telegraph Cable has been broken.

In Algeria, in the neighbourhood of the Garrison of Nemours, all the Telegraph wires have recently been cut, by the Moors, who made a hostile incursion into the French territory.

From Alga Grande (Sicily) to Naples, in connection with the recently laid Malta and Sicily line, a special wire is to be immediately erected, so that telegrams from Malta will be sent direct to that capital without retransmission on route.

The Cagliara Cable.—The Steamer *Berwick* went ont 26th September ult., from Malta, to attempt to pick up the last portion of this Cable.

In France, the first Electro Telegraph Line established was from Paris to Rouen; for this undertaking, intended as an experiment, the first credit was opened by a Royal Order, at the end of 1844. Next came that from Paris and Lille, and the Belgian Frontier. In 1855 under the Empire all the chief towns of departments were connected by wires, with the capital. In 1857 the number of stations in activity was 178; in 1858 they had increased to 193. Up to last year there were 13,030 Kilometres of Telegraph wire working in France. The lines were first opened for private correspondence on the 1st March 1851. There were then, but 17 working stations, and the number of messages sent by the public that year, was little more than 9,000. In 1856 there were 368,000; in 1857, 413,000; and in 1858, 463,000; showing an increase of 50,000 in each of the last two years. The produce of the messages which was but 1,500,000 fr.; in 1853, rose successively, to 3,333,000 fr. in 1857; and to 3,516,000 fr. in 1858. The private despatches now pay the expenses of the Electric Telegpaph; they even leave a profit, and they procure, besides (adds the *Constitutionnel*) to the state, the gratuitous use of the most admirable instrument of Government that ever existed.

The Density of Steam, at all Temperatures has been the subject of recent experiment by Mr. W. Fairbairn, F.R.S. Amongst the results obtained are the following:—1 cubic inch of water expands into 1670 cubic inches of steam at 212 deg. Fahrenheit; into 882 cubic inches of steam at 241 deg. Fahr.; and into 400 cubic inches at 304 deg. Fahr., and so on.

Lightning and Telegraph-Wires.—In America more than in Europe, Telegraph-wires are remarked to be highly sensitive to an approaching thunderstorm. Indeed, a thunder-cloud when near, passing over the wires, may charge them to such an extent, that the electricity may fuse the thin wire of the Electro-magnet, and render the magnet itself unserviceable. On some occasions an explosion takes place in the Telegraph-room sufficient to fuse thick wires, and to expose the clerks to considerable danger. A weak charge of atmospheric electricity has the same effect on the wires as the current of a voltaic battery: it makes a point in the Telegraph register. If, however, a storm pass over the wires, these points become numerous; and, as they show themselves between the points of a Telegraphic Message (Morse's system is here alluded to) they make the writing indistinct, and often illegible, so that on such occasions the Clerks usually suspend their labours.

Australian Lines. The Electric Telegraph to Melbourne and Adelaide is in constant use, and already affords a remunerating revenue; to Bathurst and to Maitland, additional wires are in progress, the amount of business transacted having forced on the Government the absolute necessity of a second wire.

The Red Sea and India Telegraph Company commenced operations on the 1st October ult., between Alexandria and Aden.

At Milan, during the prevalence of the late atmospheric changes, a powerful water-spout broke over the country, between Castel Pusterlengo and Pizzighaltone, and destroyed five kilometres of the telegraph-line between those two places.

In Piedmont, and at Turin, on the 2nd September ult., an electric current, of extraordinary intensity, and varying its direction every moment, manifested itself on the lines of Pignerol, Mondovi, and Savoy. The needles, both of the vertical apparatus, and of the common horizontal compass, deviated strongly from their normal position, sometimes to the right and sometimes to the left; the keys in Morse's apparatus remained fixed to their respective axes, which acquired strong polarity. With the vertical electroscope sudden changes of direction were observed to occur with an intensity varying between 10 and 60 degrees. At Turin, the angles of deviation of the magnetic needles were observed to be very regular; there was a constant return to the magnetic meridian, where they stopped an instant or two, and then declined again, with diminished force. Deviation of each current, 60 seconds; interval between each, 30 seconds. Currents commenced at 5 a.m. and continued decreasing in intensity, until they finally ceased at 3 p.m.

In India, the first European telegraphic intelligence was received (through the Red Sea Telegraph) at Calcutta on the 8th August last.

Atmospheric Electricity and Telegraph Wires. A curious atmospheric phenomenon was observed on Friday morning, 2nd September, 1859, on the electric telegraph wires round Paris. At 7 o'clock, when the service commences in the various stations, it was remarked at the central station placed at the Hotel of the Minister of the Interior, that some of the instruments were charged with electricity, as if the corresponding station had sent a constant current. It was soon found that the fact was general, the wire at all the stations being in the same state. By interrupting the circuit of the wires, strong sparks were obtained. The same thing was produced at the same time on all the telegraphic wires throughout France, the stations placed between two lines receiving the current from each side at half-past 9; the electricity, in place of being permanent, showed itself only at intervals. In stormy weather, atmospheric electricity produces many discharges, which set in motion the telegraph machines; but these discharges are instantaneous, and have not a permanent character.

Between Constantinople and Smyrna, the telegraph cable, by Messrs. Newall and Co., is said to have been successfully laid.

The late Atlantic Cable. The [American] Western Union Telegraph Company, it appears purchased ten miles of the Atlantic telegraph cable, at 250 dollars per mile, to go across rivers and bays. The first was laid across the Mississippi, at St. Louis, 2,700 feet: this worked well at first, but was a total failure at the end of twenty days. It was then under-run from shore to shore, so as to see every inch of it, but no defect was visible. Other 2,700 feet were laid which worked two days only, and failed also; various other trials were made, but with no better success. The probable cause of this, apparently, total and organic deterioration of the great cable is variously commented upon; the favourite theory appears to be, that the cable has been strained, or "parted" in an indefinite number of places, say 10,000, or drawn so unevenly fine, as to be melted by the first current passing through it.

Colonel J. B. Shaffner has sailed from Boston, in the barque *Wyman*, on a voyage of exploration to the North Atlantic, in search of a feasible route for a line of telegraphic communication between this country and Europe, by way of Greenland, Iceland, the Faroe Islands, and Scotland; his object being to examine the seas, the bays, and the lands contemplated to be traversed.

In Greenland and Iceland, the King of Denmark has granted the exclusive right to Col. Shaffner, to lay a telegraph cable, viz., from the shores of Labrador to South Greenland, thence to Iceland, and thence to the Faroe Islands, where the wires will branch off, one southward to Scotland, the other to Bergen in Norway. The longest stretch of cable will be from Labrador to Greenland, about 500 miles.

Red Sea Telegraph.—[Kurrachee with Aden]. Messrs. Newall and Co.'s Steamer "Imperador," left Liverpool 3rd October ult., for the East, with the remaining portion of this cable. Hallani, one of the Kooria Mooria Islands, has been definitively fixed upon as a Station for this Telegraph.

Channel Islands.—The Telegraph-wires from Jersey to Guernsey have broken at 4 miles distance from Jersey. Rest of the Line safe.

The Isle of Man Submarine cable has been announced to be again in working order.

Between Malta and Sicily the laying of the cable has been safely completed. On the Malta side, the shore end had been laid down and connected with the Company's offices, before the expedition started; the outer end about 1 mile off the Marsamuscetto Harbour being buoyed, ready to complete the communication from shore to shore, when the Cable was submerged. The "Berwick," accompanied by her Majesty's ship "Argus" left the Port on the 21st at 8 a.m., and arrived at Alga Grande (on the opposite Sicilian shore) at 2.30 p.m., when the shore-end of the Cable, weighing 4 tons to the mile, was landed in one of the paddle-box boats of the "Argus." The terminal pole, connecting the cable with the land-wires, was erected, with the necessary fittings ready to join the Neapolitan system of Telegraphs at 8.30 p.m.; and at 9 p.m. the operation of paying out the cable commenced, and continued, without accident, until the arrival off the Harbour, at 7 a.m. of the 22nd September, when the final splice was made and safely lowered. Mid-portion of the cable of great strength, being equal to bear a strain of 10 or 12 tons without parting; shore-ends of nearly double that strength; depth of water throughout within 80 fathoms. Land wires on the Sicily side not quite ready, but completion being pressed forward night and day.

Atmospheric Disturbance.—At the close of the recent British Association Meeting at Aberdeen, a resolution was adopted by the council recommending an application to the Board of Trade to forward the object of providing for Telegraphic communication between distant parts of the empire, in case of storms.

The Isle of Wight Wire between Cowes and Newport has been laid down. It i an underground wire insulated with india-rubber, (Silver and Co.'s Patent) and it is incased in an outer covering of hemp and asphalte. When the wires to Newport are completed they will be continued to Ryde and Ventnor, so that the principal towns in the island will be in electric inter-communication with every other part of the Kingdom.

Military Telegraph Lines.—The Magnetic Telegraph-wires have been extended to the camp at Curragh, and a competent officer has been appointed to the duty of receiving and despatching messages between head-quarters. Every garrison town, it appears, is to have similar communication; and the salient points on the Irish coast, such as Bantry, will each have its Telegraph-wire. This will form a material element in the contemplated system of coast-defences.

Greek Lines.

Syra to the Isle of Chio.—The contract (late advices from Athens) for the further laying down of this cable has been conceded to the Newall Company, at £13,000. Cyprus and Rhodes are to be on the line.

Syra and Crete.—The cable (Newall) which had been laid between these points had to be pulled up, as it was found that a worm *(teredo)* had eaten through the coating of gutta-percha, especially in the waters round Milo.

Along the Gulph from Athens to Patras a line has been laid by the same company.

From Patras to Zante and Corfu, a line, from the above, is about to be carried.

Telegraphic Messages to Malta, passing from England and vice versâ through Italy, have hitherto been required by the Neapolitan Governments to be in the French and Italian languages. Recently the French and the Mediterranean Extension Telegraph Companies have received an official communication from the two governments that this regulation is abrogated. Henceforth, therefore, such messages can be forwarded to and from Malta through Italy in English. As to messages intended for places in Italy itself, the old regulation remains in force.

CASUALTIES TO STEAMERS.

Her Majesty's Steam-Sloop "Heron." The survivors (second master, and 19 of the crew) of this ill-fated steamer, which went down during a tornado on the African coast, arrived recently at Woolwich Dock Yard, and were berth'd on board the *Fisgard* flag ship. The *Heron* it appears went over, and sank in so sudden a manner, that it is a matter of surprise that even a single life was saved. She was fitted out at Chatham, and left England for the African Station about eighteen months ago; she was a vessel of the same class, in every respect, as the *Sappho*, which was lost a few months since.

The "Bride" Thames Steam-Boat, belonging to the Iron Steam Boat Company, whilst conveying her usual number of passengers, through the second arch on the Middlesex side of London Bridge, suddenly struck upon a sunken iron barge with such force that some of her plates were driven in, and she filled rapidly. The captain and crew were safely conveyed on shore. The steamer sank to the bottom of the river. When she struck, she veered round, her head coming in front of the tide, and filled directly. Her stern was visible at mid-tide.

A Steam Pipe Explosion occured recently, in Plymouth Sound, on board Her Majesty's screw steam-sloop *Pioneer*, under orders for the West Coast of Africa. She was getting up steam to proceed into Ramsgate, to make good some defects, when the main steam pipe burst close to the communication. The leading stoker, who was on the point of opening the communication-valve, suffered severely, as did also the engineer in charge, and several others of the crew. The ship was speedily enveloped in steam; the looking-glasses in the captain's cabin were shivered, and the boots shrivelled. The steam-tender *Confidence* went to the assistance of the injured men, of whom seven (the worst cases) were conveyed to the Naval Hospital.

During a Cyclone in the Hooghly, (recent intelligence at Lloyd's, from Calcutta, to 26th July ult.) two steamers, and a number of other vessels, were wrecked. Fears were entertained of the Cadea on this occasion; but the Bombay agent of the Peninsular and Oriental Company has since written that she passed up the river in safety.

The Australian Mail Steamer "Northam" has been lost between Aden and Suez; part of the mails, crew, and passengers saved.

The Screw Steamer "Harbinger" which left Algoa Bay on the 23rd July last, returned on the 25th with loss of foremast and jibboom, and making 3½ feet of water per day. Tenders had been called for her repairs, but from the amount required, it was probable that she would never leave Algoa Bay.

Paddle Light Boxes—Spontaneous Combustion. An instance having occured on board Her Majesty's steam-vessel *Sedon*, of combustion taking place from certain articles being inadvertently placed in the paddle light-box, where the rays of the sun were concentrated by the bull's-eye, the Admiralty have recently given directions that the attention of all commanding officers of Her Majesty's ships and vessels be called to the circumstances, with a view to the prevention of fire from a similar accident in future.

The "Black Diamond" Steamer of and for London, from Narva (recent advices from Copenhagen) had been on shore on Gothland, and again on Ocland; got afloat with assistance after throwing a part of her cargo overboard; arrived at Copenhagen 1st September ult., leaky.

Her Majesty's Paddle-Wheel Steam-Sloop "Gorgon," 6 guns, from Plymouth for Halifax, had to put in Cork Harbour, with loss of foretopmast, and three men; she is now alongside the Quay at Haulbowline, undergoing her necessary repairs.

The Steam-Tug "Olive," belonging to the Commissioners of the River Wear, whilst recently lying in the half-tide basin on the sea-outlet to Sutherland Docks, was observed to be in flames. She was with great difficulty shifted into the outer basin, and, within an hour of the discovery of the fire, all attempts to save her having failed, she was scuttled. The heat on board was so intense that her engines and machinery were red hot. There was steam in the boiler during all the time of the conflagration, but, fortuaately, no explosion occurred. Insured in the County Fire Office.

The "Mersey," Royal Mail Company's Steamer, (late advices from Buenos Ayres) does not appear to give universal satisfaction. The paddle-wheels are said to be too small, to make head-way against the strong winds occasionally experienced on the passage from Janerio. It is believed the discarded *Camilla* would have done better than the *Mersey* the last voyage, as being more adapted to navigation in smooth water than in rough seas.

The "Persia's" Port Engine broke down recently, the crank pin breaking short off.

The "Paramatta" [Wreck] was still (late advices by the *Atrato*,) on the Aneghada Reef: whether she could be got off, doubtful, as she had to be floated, and the bulkhead being constructed for that purpose, involving an extra weight of about 100 tons.

MILITARY ENGINEERING.

Iron-plated Ships.—The result of the series of experimental trials, recently carried on at Portsmouth, with a view of ascertaining the amount of resistance offered by iron and steel plates, of various manufactures, when opposed to heavy ordnance at a short range, and which trials are understood to have reference to the future coating of the steam-ram now in progress of construction, appears to be unfavourable to the presumed efficiency of iron or steel coating as a preservative to war-vessels. The practice was carried on from the *Stork* gunboat, tender to the *Excellent* gunnery-ship in Portsmouth Harbour, both from a 32-pounder and a 95cwt. gun; the latter throwing a solid 68lb. shot with 16lb. charge of powder; distance of range 200 yards. At this distance the experiments demonstrated that no iron or steel plate that has yet been manufactured can withstand the solid shot from the 95cwt. gun at a short range. The first shot would not penetrate an iron plate, but it would fracture it; and, on 3 or 4 striking the plate in the same place, or in the immediate neighbourhood, it would be smashed to pieces;—that a plated ship could be more easily destroyed than a wooden-sided one, and that by the smashing in of one of the steel plates the destruction of life on the armed ship would be dreadful, from the spread of the splintered material—that is, supposing the broken plate to be driven through the ship's side. An iron or steel-clad ship, on receiving a concentrated broadside from a frigate armed in a similar manner to the Mersey, if struck near her water line, must infallibly sink.

The Rifle-Range at St. Mary's Creek is to be abandoned by the Chatham garrison on account of its being, of late, much frequented by the public.

Iron-plated Frigates.—The French Government has, it is confidently stated, given orders at Creuzot for the construction of 20 frigates iron-plated (*frigates blindées*).

One of Sir William Armstrong's Guns, an 80-pounder forged at the Elswick Factory, was recently tested in the long range at Shoeburyness, in presence of the Ordnance Select Committee of Woolwich Arsenal, and gave most wonderful results as regards accuracy, &c. The flight obtained was 9,000 yards, or upwards of 5 miles.

A newly-invented Fulminating-Bomb has been tried with great success on the Mense. The *Academie* has been summoned to take note of the invention, and report upon its value.

Another (the Jeffries) "Long-Range!"—A new long-range cannon, invented by Mr. Jeffries, Patentee of the well-known Marine-Glue, is in course of being mounted in the Royal Arsenal, Woolwich, for experiments at Shoeburyness. Its range, or flight of shot, is spoken of as likely to eclipse every other weapon hitherto known. The gun, with its present bore, a 3-inch diameter, weighs 7 tons, and presents an appearance, with the exception of the present calibre, similar to one of our 68-pounders. The charge will consist of 16lbs. of powder and a conically-shaped shot, weighted with lead to 9lbs., and hollowed similarly to the Minié bullet. The Authorities intend carrying out a varied and complicated course of experiments under the inspection of the Select Committee of Woolwich Arsenal. After being satisfied of its power in its present form, the bore will be progressively increased to a 68-pounder. To enable the gunners to point the gun, the trunnions will be fitted with a couple of telescopes, to assist the eye over the enormous range predicted.

Hollow Shot filled with Molten Iron.—The *Colossus*, 80, screw steam-ship, lit fires recently in the steam-basin at Portsmonth, to test the efficiency of her furnace in the filling of hollow shot with molten iron. The *Serpent*, target brig, was selected as a mark on which to try the effect of these fearful missiles, fired from on board H.M.S. *Excellent*. The furnace worked in a most satisfactory manner, supplying without any difficulty fully one ton of molten iron per hour. The hollow iron globes, filled with melted iron, were conveyed from the *Colossus* in an iron bucket to a boat on the opposite side of the quay, which pulled aboard the *Excellent*. Average time, from the metal being run off from the furnace until the missile left the mouth of the gun, 6 minutes. Range for trial (short) 800 yards. Altogether, 10 shots fired, 2 of which burst; but the metal inside of them had lost too much of its liquidity, from the length of time it had been drawn from the furnace, to produce the effects intended in its liquid state. Further experiments adjourned.

Modern Mongolian Tactics. The Mud-pit Strategy on the Peiho.—An eye-witness of the disastrous affair of the gunboat attack on the Chinese Forts, 25th June ult., gives a curious specimen of the cunning expedients for defence, resorted to on that occasion by the astute and, it must be admitted, far-sighted Mongolian General, "Prince Sangkohlinsin," or Sang-ko-lin-sin. The mud-bank in front of the South Fort runs out, it appears, a long distance, with very little shelving, and the water on it is consequently very shallow. In each spring the water at the mouth of the Peiho is much shallower than in June. Prince Sangkohlinsin, when the water was low, got circular pits dug in this mud-bank at irregular distances. When the attacking party returned to the Peiho, these pits were invisible, being under water; while, at the same time, the water was too shallow to float our boats full of armed men. The result was, that the storming-party had to jump out in the very place where the trap was laid; so that on all sides men were to be seen suddenly disappearing in those pits, and then struggling out with their rifles covered with mud, and useless. Thus three-fourths of even those who reached the front could not fire a shot; and, consequently, the Mongolian sharpshooters in the fort knocked over their assailants as easily as though they were firing into a battue of game. Despite of all this, between 300 and 400 men reached the firm ground, and would have carried the fort by storm in the face of all opposition, but no scaling-ladders were forthcoming! Those same mud-pits had caught the men carrying the ladders! As soon as one of the bearers got into a pit, the ladder, of course, tumbled off, and either stuck fast in the mud, or got broken in dragging it up. To this strategy of the mud-pits we, [the assailants,] adds the same eye-witness, owe our repulse. No human wisdom could have foreseen the snare; and it clearly proves that, in this Mongolian prince, we have met with no ordinary foe.

Shot-resisting Qualities of Stone.—At Portland, the Defence Commission, recently appointed for the House of Commons to inquire into the state of the National Defences, lately witnessed some interesting experiments for the practical testing of the relative shot-resisting merits of the Portland Roach Stone and Cornish Granite. A massive piece of masonry, representing a section of the circular batteries about to be erected on the Breakwater, was built at the foot of the cliff on the north shore of the Island, and was subjected to a close and well-directed fire from a 68lb. gun from H.M.S. *Blenheim*, which had taken up a position about 500 yards distant. Result of firing satisfactory, as affording data to the War Office as to the relative strength of the different stones, one-half of the section being roach, and the other granite.

Modern Chinese War Tactics.—During the recent affair with the Mongol forces, according to the report of one of the officers on board of H.M.S. *Highflyer*, present at the attack, 25th June ult., on the Chinese forts at the entrance of the Peiho—"When darkness came on, the Chinese discharged globes of fire from their guns, which enabled them to see their enemies, and to aim at them." [The disastrous results of this manœuvre to our gunboats we well know. Is not this a case for the future application of the maxim—"Fas est ab hoste doceri"?—*Ed. Artz.*]

Firing-Practice with the Armstrong Gun has now become a regular part of routine military duty. A detachment of the Royal Artillery recently left the Camp at Aldershot for Shoeburyness, to practise firing with this gun. They are to be succeeded in a few weeks by a party from the Camp at Shorncliffe.

The Armstrong Guns, now in use in Shoeburyness, carry 5 miles, and hit the mark with precision each time.

The Weymouth Harbour 3-gun Battery, to sweep the entrance, has been completed. The Royal Engineers have commenced erecting here a 50-gun battery, which, when completed, will be mounted with Armstrong's long range guns.

The new "Gunpowder-Gas" Engine, the invention of Sir John Scott Lillie, underwent, 8th September ult., inspection and trial by a Special Committee of Ordnance Officers at East Greenwich. Great secresy has been observed respecting this new and, as it is understood, astounding invention, by which one man was, on the above trial, enabled to discharge, by turning a valve, 120 bullets a minute, for an unlimited period of time, through rifled barrels—a feat impracticable with Perkins's celebrated steam-gun, with which such rapidity of fire could only be maintained for a very few minutes, several hours being required to generate the high-pressure steam of 600 to 800lbs. The steam-engine with its ponderous boiler was, moreover, stationary, and unfit for general warfare; whereas the "Gunpowder-Gas Machine" is as easily transported as field ordnance. [In Toplis's "Pacificator," produced several years ago, and for some unaccountable reason or other never since heard of, the balls were propelled through a barrel by a continuous stream of the gases evolved from a cylinder filled with "slow rocket-mixture," inserted (renewable by a species of breech-loading arrangement). There are other somewhat suspicious features of relationship between the "new" (?) "Gunpowder-Gas Engine" and its predecessor, to which we may have occasion again to refer.—*Ed.*]

The Fortification-Works at the Slack Rock, Milford Haven, have been com menced. They embrace the whole of the Rock in one large fortification, mounting 96 guns. This is only the commencement of a series of fortifications upon a large scale, intended, ultimately, to render Milford Haven all but impregnable to any invading force.

Swivel Batteries, for the fortification of the French coasts are much talked of in Paris, they are described as a new system of iron plates, turning on a pivot, which will permit the guns for shore defences to be pointed in every direction the enemy can take.

The Chinese Fire-Balls used by them at the recent affair on the Pehio are thus described in Prince Sang-ko-lin-sin's own official report or memorial of the action. "As we could not tell bow far these rebellious barbarians (*i.e.* tbe besiegers) were off, our (the Chinese) soldiers kept them back by projecting fire-balls through bamboo tubes, and as these blazed up, our guns and cannou being laid, by firing into them at point blank range till, &c., &c."

For the Fortifications of Antwerp a public adjudication of contract for the works would by order of the Belgian war-department, take place at Antwerp on the 31st October ult., in one lot, and at a fixed price. The whole of the works the Department estimates at 40,000,000 francs. A guarantee deposit of 1,000,000 francs is required on eacb tender sent in. Another condition is that the works must be terminated within 3 years.

Steel Conical Shot.—The floating battery "Trusty" was (27tb September ult.,) moored off Shoeburyness for the series of experiments with a heavy 56 cut Armstrong gun, firing this species of sbot at targets painted with bull's eyes, on her broadside. A number of scientific gentlemen of the navy and ordnance were present to superintend the experiments. The result was, that within a range of from 400 to 200 yards, the broadside-plates were broken to pieces; the shots often penetrated through her broadsides. Shots, witb the greatest accuracy of firing (the gun being laid by a gunner from the "Excellent") were sent into an open port, and went through tbe timber materials on the other side, driving off, and breaking the plates to pieces. At the conclusion of the experiments the "Trusty" floating battery was towed back to her moorings in Upper Reach, near Chatham for examination. A subsequent official survey of the state of the Trusty, consequent on the experiments, has elicited the unanimous opinion of the officers who examined her, that vessels of this class will be found to be almost entirely useless, wben fired upon by guns of the Armstrong class.

The Large Mortar-Vessels which have been lying in Chatham barbour, are to be overhauled, and examined by a board of officers, to discover whether the marine-worm has made any ravages in the timbers at the bottom, during the time they have been laying up. For this purpose, two of them, Nos. 31 and 48 which are intended for the operations in China, were, 27th September ult., removed into the first dock. Should the timbers be found to have been attacked by the destructive insect, such timbers will be replaced by new ones; after which, tbe bottom will be covered witb the composition which has been introduced into the navy.

For Gunnery Experiments on iron and steel plates. The "Undaunted" target frigate Portsmouth Harbour, has bad some iron and steel plates affixed to her port-side. Three of these plates are the manufacture of Messrs. Palmer Brothers, of Newcastle, and are of the respective thicknesses of 4, 3½, and 3 inches.

"Monster Vessels."—As bearing on certain misgivings still understood to be entertained in some quarters relative to the probable future destiny of the *Great Eastern*, we may recal to mind that the ship nearest in size to it safely reached England from America, about 30 years ago. She was called the *Baron of Renfrew*, was 600 feet long, and was composed of large logs of timber, clumped together in the roughest manner. It was predicted that she, too, never would cross the Atlantic; but she did, and immediately on her arrival, was broken up. Indeed, she was nothing more than imported timber, having been patched together to avoid the timber duty, which was then exceedingly heavy. She fulfilled her mission in every way; but the Government was quickly on the *qui vive* to nip the new dodge in the bud, and prevent any repetition of the experiment.

ACCIDENTS FROM MACHINERY, &c.

Defective Diving-Apparatus.—At Ramsgate, a Diver was drowned, on the 2nd October ult., while at work, (examiniug the wreck of the "Robert Gardener," and attired in the usual garb of a diver), in consequence of the bursting of the air-pipe while he was under water. Verdict, "accidental death from suffocation, in consequence of the bursting of a pipe."

Unprotected Machinery of a Steamer.—On board the Turkish Corvette, "Brussa," lying in Plymouth Sound, a fatal accident occurred, 5th October ult. When about half way between Portland and Plymouth, bound for Constantinople, her engines broke down, and she was compelled to put into port. A man fell from the main-deck down through to the engine-rooms, and falling on the machinery, was killed. At the inquest held on the body, 6th October ult., the Jury, in returning a verdict of "accidental death," recommended that the Captain of the vessel be requested to see what plan could be adopted so as to prevent a similar accident occurring again.

HYDRAULIC ENGINEERING.

Two Patent Hydraulic Cranes (Sir William Armstrong's Invention) have been placed on the jetty, at the Newcastle-on-Tyne works, for the Armstrong gun, (Elswick Ordnance Works). Of tbese cranes, one is to lift 3 tons, the other 12 tons. They are worked from an "Accumulator" placed in the erecting shop, and will lift or lower goods at the rate of 6 feet per second. To ensure strength and safety, the jibs and pillars are made entirely of wrought iron.

At the New Swansea Docks, the whole extent of the enclosure, as well as the river, float, is furnished with Sir William Armstrong's Hydraulic apparatus, which opens the gates, swings the bridges, works the sluices, lifts the hoists and performs all manner of operations, light or gigantic. The extent of pipes is one mile and a half; and the pressure upon them is 700lb. to the square inch. The hydraulic power is available at any point throughout the entire length of the pipes; and for accumulating this power, a steam-engine of 80 horse power has been erected, machinery so arranged that the pipes connected witb the float and those connected with the docks, may be worked quite independently; so that an accident to one branch of the apparatns need not affect the other. It is supplied with self acting gear; and by means of chains which run the whole length of each side of the lock, the starting valves of the engines may be opened or closed in a moment, by persons working the machinery without running to the engine-house for the purpose, simply by working levers attached to the chains. Any portion of the machinery can be thrown into or out of gear immediately; and either part worked independently of the others. The fitting of the apparatus cost the trustees about £20,000.

DOCKS, HARBOURS, &c.

At Riviere de Loup, the Canadian Government are, it is reported, about to construct a harbour, and erect wharves, in order to expedite the transmission of mails to and from the West; the steamers will thus avoid the most dangerous part of the navigation, often impeded by dense fogs. The entrance to the proposed harbour (a point at the termination of the railway, 160 miles below Quebec) already forms a natural basin, with 12 feet at low water over the bar.

The North Devon Dock [and Railway] Company, at their recent half-yearly meeting, declared a dividend of 18*s.* 9*d.* per cent. on the ordinary stock of the Company for the half-year, of which the net revenue was £2,602 13*s.* 9*d.*

The Southampton Dock Company, at their last half-yearly meeting, declared a dividend of £2 for the half year, the net revenue of which was £7,990 1*s.* 7*d.* The inner dock, opened on the 26th May last, cost £60,000.

The large Steam Basin at Chatham, for the reception of a reserve fleet of steamers is in progress. These works, which are of great magnitude, are being carried on at the extreme east of the dockyard at St. Mary's Island. Several hundred convicts have been employed on the Island for some time past, on the construction of the river-wall, and in making preparations for commencing the foundations and excavations for the basin. The works are under the superintendence of Mr. Macdonnel.

At the Cape, tbe foundation stone of a patent Slip and Pier, at St. Saviour's Bay, was laid by His Excellency the Governor, with great ceremony, on the 14th July last. Tbe cost (£16,000) of this, locally considered, important undertaking, will be met by private capital. The contractors agree to keep the slip in working order for twelve months. Engineer of the Works, Mr. Onions. Expected to be completed within a year.

The Crystal Palace Steam-Boat Pier at Battersea, was, recently carried away by the unusually strong tide in the river.

The New Beacon on the Monkstone Rock, in tbe Bristol Channel, has been successfully erected; the wrought-iron mast and globe being permanently fixed in tbe place prepared to receive them.

From the New Steam-Boat Pier at Cowes (Cowes and Newport Railway) the new street to the railway terminus, is to be 65 feet in width.

At Chatham Dock Yard, the works in progress (at tbe east end) for improving and deepening the harbour, and extending the dockyard, were recently inspected by tbe Lords of the Admiralty.

The Canal to unite the Caspian to the Black Sea, by tbe Sea of Azoff, is again confidently spoken of. The Russian journals state that the Government has once more taken up the project, that the realization of the plan has been decided on in principle, and that surveys are to be made to carry it into effect.

Two Lighthouses in the Straits of De Fuca, near Victoria, British Colnmbia, are to be forthwith erected. The governor has asked the House of Assembly to provide means for maintaining tbese lightbouses when erected. The want of lights had been found to be a great impediment to the navigation of the straits, and to the entering the Harbour of Esquimault, which is low and unseen at a sbort distance seaward.

The Portland Breakwater is making rapid progress, and has, already, advanced about 2,400 yards from the north-eastern extremity of the island, and shelters an ancborage of upwards of 1,200 acres. Number of men employed in the construction of these great works over 700, in addition to 1,000 convicts, and augmenting daily.

The Want of adequate Docks for our steam navy, &c., has been lately exemplified in a practical manner. The screw-frigate *Ariadne*, 32, and 800-borse power, nominal, launched a short time since at Deptford, was, recently, ordered to be brought to Chatham Dockyard to be made ready for sea, in consequence of there being no dock at either Woolwich, Deptford, or Sheerness, large enough to receive her. She is, consequently, to be docked in the dock now occupied by the screw-frigate *Charybdis*, 21.

Sinking of the Birmingham Canal at Tipton. The ground, under a portion of tbis canal at Tividale, near the new tunnel, has suddenly snnk 8 to 10 feet, the water pouring out into the adjoining fields. Fears were entertained that the water would enter the mines. The accident is attribnted to workings in the limestone underneatb. Some 2 acres of ground sank.

For Dock-Gates, the relative merits of iron and wood lately formed the subject of discussion at a meeting of the Mersey Dock Board. The qnestion turned npon tbe comparative merit of "green-heart" timber and iron in the construction of dock-gates. The iron gates, at the Victoria Docks in London, were instanced as an example of the efficiency, durability, lightness and ease in working which characterise iron as a material for this purpose. Mr. Hartley, the dock-engineer, said that the gates in qnestion were found very expensive, and involved frequent repairs. In the construction of tbe gates for the new works at Birkenhead, be intended to use iron, but only for tbe ribs, the planks being of green-beart.

At Swanage, Dorsetshire, the first stone of a new pier has recently been laid, with much ceremony.

For the Birkenhead Dock Works, the Mersey Harbour and Dock Board, at one of their recent meetings, accepted tenders for the supply of 300,000 cnbic feet of Baltie timber; and 15 standards of spruce deals, required in the construction of the large low water basin at Birkenhead.

The Ship Canal, through Lake St. Peter, between Qnebec and Montreal, Canada, lately made by the Harbour Commissioners of Montreal, has given rise to considerable local discussion. The Commissioners want the Government to assume tbe debt incurred for its construction, on the ground that the work is a public one. The leader of the opposition in Upper Canada, asserts that the work is a local one; and a warm altercation is the result.

Upon the supply of Coal to the Metropolis [per Canal], during the year ending the 1st October ult., as compared with the same period of 1858, there has been a decrease in traffic of 2460 tons 10 cwt.

The opening of Swansea New Docks, an importan addition to the shipping accommodation of the port, took place on the 22nd September ult. They are built on the west side of the entrance to the port, and consist of an inner and outer, or half tide basin. The inner basin isexcavated to a depth of 29 feet 6 inches; the entrance, to 28 feet; area 13 acres; length 3,500 feet; breadth 360 feet; with 4,800 feet of quay-wall. It communicates with the half tide basin, by a dock of 300 feet long, and 60 wide, and will accommodate steamers of the largest size. The half-tide basin contains an area of 4 acres; and is 430 feet in length, by 370 in breadth. It has 1600 feet of quay-wall. Depth of water throughont, 24 feet, and on the sill at the entrance gates, the depth varies from 26 and 23 feet at spring tides, to 15 feet at the lowest neaps. Entrance 70 feet wide; being 15 feet wider than the entrance to the Bute Dock, recently opened at Cardiff. Engineer, Mr. Abernethy. Contractors, Messrs. Tredwell. At an expense of 75,000, the Harbour Trustees have constructed an extension of the Sonth Wales Railway, down to the edge of the inner basin. [Vide "Hydraulic Engineering," present number.]

Cairnlough Harbour, [in Ireland] has been deepened; and the dredging and otber works completed; lighters are no longer required to ship the limestone, and vessels can now enter in all seasons.

At Grangemouth, the new Canal Basin, contracted for abont midsummer 1858, has just been completed at the exterior of the Canal Company. The alterations being made on the locks at the basin, by rendering them so as to admit the largest ships into tbe timber-basin, are also began, and will shortly be finished.

The Receipts at Harbours and Ports, for 1858 as per official return to the House of Commons, pnblished 1st October ult., were as follows:—Dover, gross receipts, £19,002; expenses £16,465, surplus in favor, £2597:—Whitby Harbour, gross receipts, £5,303; expenditure, £5,045; deficit, £63; in the 2 preceding years, the accounts for this harbour, showed an excess of receipts over expenditure:—Ramsgate Harbour, receipts £20,655; expenses £21,652; deficit £1,003; accounted for by ontlay of £3,883 on a new steam-tug. Hull and Newcastle both show an excess of receipts over expenditure; in tbe former case of £3,578; in the other, of £651; the sums expected being £25,920 and £15,975.

BRIDGES.

The Victoria Bridge "Ice-breakers."—The new Montreal Bridge (Canada) presents one peculiar characteristic of the ingennity and skill of its designer, the late Mr. Robert Stephenson—we allude to the construction of the piers and ice-breakers; the latter foim ing a part of the former, and being in the form of sloping cntwaters, on tbe np-stream of the St. Lawrence side, their fronts presenting an angular face to tbe ice. Tbe object of this arrangement was not to stop or defy the ice, but to coax it, as it were, to climb to the top, when the overbearing sides of its mass would gravitate, parting it in the middle, and the two halves would pass harmlessly away through the openings. Actual experience has already proved the correctness of this calculation; and, during the four years this bridge has been in course of construction, the stone "ice-breakers" have stood the severest test of the "breaking-up," "packs" and "shoves" without injury.

The Masonry in the Piers, "Ice-breakers," and Abutments of the above bridge, or rather immense iron viaduct, amounts to nearly 3,000,000 cubit feet; a quantity which would cover an acre of ground, piled solidly, to a height of about 64 feet, and its weight 220,000 tons.

The Iron in The Tubes, made at Birkenhead, and sent out, punched and ready for fixing to Canada, is held together by upwards of a million and a half of rivets. The Victoria tubes are not on the "cellular" (as in the Britannia) principle; they are, indeed, the largest tubular beams ever constructed without cells. The line of iron tubing will extend a mile and a quarter in length, stretching from shore to shore, making 25 strides across the St. Lawrence, the central span measuring 330 feet.

Railway Bridge Building Experiments in Canada.—The acting engineer, in his recent report on the Galena Railway, after alluding to the washing away, by the excessive rains, of about 200 feet in length, of an embankment on the line 40 feet high, adds, very coolly, "A truss bridge of 110 feet span, with approaches of trestle-work, *is now erected over the gap*. The bridge rests, *for the present*, (!) upon temporary trestle-bents. It is *designed* to build stone abutments for its support." (! !) [Meanwhile, however, it appears that the bridge rests merely "upon temporary trustle-bents;" the "stone abutments" will, in all probability, be postponed until some terrible catastrophe shall have opened the eyes of engineers, directors, and the American public on the subject of the necessity of efficient supports to railway bridges.]

The Charing Cross (now Hungerford Suspension) Railway Bridge.—Mr. Hawkshaw, the engineer to the Charing Cross Railway Company, is now engaged in the preparation of the working-plans for the new bridge over the Thames. It will consist of 4 lines of rails instead of 2, as originally calculated for in the estimates, and this will increase the cost of the works by about £60,000. The 2 existing piers of Hungerford Bridge will be used for the new one, as they are of sufficient width, if carried up from their lower part, to admit of a roadway of 4 lines of rails. The footpaths on either side will overhang the piers. The bridge will be supported by 5 piers, and will, nevertheless, be light in its appearance. In connection with the bridge, there will be a spacious landing-place for steamboat passengers, with broad flights of steps conducting to the railway station, and the footways on each side the railway bridge. The revenues derived from foot-passengers, and from persons using the landing-pier, will be the property of the Charing Cross Company.

The Victoria (Canada) Bridge, commenced in 1854, will be finished in November. Cost 7,000,000 dollars; has 10,000 tons of iron in the tubes; 2,000,000 rivets; and 168 acres of painting; the tube being painted 4 times in oil and colour, and each giving 32 acres; contains 25 openings of 242 ft., centre span being 330 ft.; hence the total length of the tube is 6,600 ft., approached by embankments, the Montreal end being 1,200 ft., the southern shore 800 ft., making a total of 9,084 ft., or 1¾ miles nearly. Abutments at the base each 278 ft. long, divided into cells of 24 feet, with intervening walls of 5 ft.; whole height of the abutment 36 ft. above summer water, the centre pier being 60 ft.; hence the bridge rises in a gradient of 1 in 132, or 40 ft. to the mile; the centre, again, being a pure level. Outer pier 24 ft. in width; remaining piers but 16 ft. The floating dams were framed structures, consisting of 2 parts; the first being 3 sides of a square figure, the sides being larger than the head, the other piece forming the square. In order to turn off the current, the head of the square was formed by 2 minor sides, turned to an angle, up stream. They were carefully and strongly framed; and, being caulked, floated of themselves. The pier of 3 sides was taken by a steamboat in tow; and when the dam was, approximately, in position, determined instrumentally from the shore, a sluice-gate was opened, and, the water passing within it, it sank at the required place. The tail-piece was subsequently towed into position. The pumps for clearing the foundations, and emptying these dams, were worked centrifugally, and threw 800 gallons a minute, passing up stones 6 inches square—the diameter of the pipe; and they were so portable, that a man could take one of these pumps on his shoulder, and move from one place to the other. These pumps lowered the area of the dam at the rate of 2 feet an hour. In 8 or 10 hours the dam was empty. In the 24 piers and the 2 abutments of the Bridge, during the 6 years taken in its construction, more than 3,000,000 feet of limestone have been placed; 5,000,000 feet have been laid every summer, equal to 5,000 feet a day, or 500 feet each hour. This is work unparalleled in the annals of masonry. Equally vigorous has been the progress in the erection of the 10,400, tons of iron, of which the 25 tubes consist; and which, as we have already seen, are bound together with upwards of 30,000,000 rivets.

The New Westminster Bridge is progressing. The removal of the facings of the piers of the old bridge on the lower, or eastern side, has been commenced, preparatory to the demolition of the entire structure. All the arches, with the exception of that next the Middlesex shore, have been turned, and a great portion of the permanent way has been laid down.

The Proposal for Improvement in Blackfriar's Bridge, by substituting one opening for the 3-centre existing arches, as regards the original conception and promulgation of the "idea," has been claimed by Mr. Samuel Peyton, Architect, who in 1854 submitted to the Bridge Committee in the City, and also to the House of Commons, a design for the renovation of the bridge with, substantially, the same suggestion.

The Steam Floating Bridge between West and East Cowes. The first General Meeting of the Steam-Ferry Company, took place, recently. at West Cowes. The new bridge is so far advanced that its speedy opening is announced. The tariff for passengers is to be one halfpenny for crossing; for one-horse carriages, 6d.; and for pair-horse ones, 1s. The new bridge will form a facile means of communication between the two towns.

The Strasbourg and Kehl railway and passenger bridge over the Rhine is progressing rapidly. The "Caissons" forming the great pier on the French side have been filled with concrete, the tubes have been removed, and the cavities also filled with the same material. The foundations are thus a completely compact mass, upon which the masonry has been carried up above water-mark, and is now receiving the first strong course of cut granite. On the Baden side only 5 metres of the excavation remain to be sunk; and on the new principal pier, the timber framework which, in the French pier, surmounted the masonry raised upon the caissons, the interior only consisting of concrete has been replaced by the use of roughly-hewn sandstone blocks, piled round the concrete. The Baden Government are to place the superstructure of the iron work of the two swing-bridges, one on each bank of the Rhine. The iron-works of Graffenstaden which furnished the caissons of the piers and the tubes are also to supply the swing bridge.

In York a Second Bridge is to be thrown over the river Ouse, so as to unite the North-Eastern and South-Western districts of the City. The Bridge will be at Lendel, and will cost £18,000. The committee of the council recommend a lattice-girder bridge of 175 feet 6 inches span, and 40 feet in width, as the strongest and best adapted for the purpose. Estimated cost of the iron work £6,950; masonry and scaffolding £7,500; roading £350; and approaches £4,000. The money to be provided for by borrowing £20,600 on the city rates, repayable in 32 years, with interest, so that the citizens will not be taxed, the receipts on traffic being designed to meet the cost.

Of the Park Bridge Viaduct, near Oldham, the foundation-stone was laid on the 1st October ult. This important Viaduct (for the Oldham, Ashton, and Guide Bridge new line) is in the Rocher Valley; and will be 550 feet long and 95 in height.

At Cologne, the great bridge over the Rhine has been completed. It is a tubular bridge both for railway and common traffic consisting of 2 tubes; one with 2 rails for the trains, the other for carriages and foot passengers; together 51 feet, Prussian measure, broad, and 1,352 feet long. The tubes rest on 3 pillars only, each 313 feet distant from the other. 5,000 tons of hammered iron have been employed in the construction of the tubes.

MINES, METALLURGY, &c.

The Coal Fields of France occupy 300,000 hectares (71,343) British acres, but from defective working, yielded in 1858 only 6,282, 700 tons of 1,000 kilogs. each. The chief coal basins, beds, fields and mines may, in regard to their importance, be ranked as follows:—Valenciennes basin a prolongation of that of Inous in Belgium. The chief works on this basin are those of Anzin coal cindery, Denair, bituminous; Raisme, poor; Fornes and Viena Condè, dry anthracity; Anichas, cindery. The yield of these beds (departments of the Pas-du-Calais) was in 1857, 22,383,800 hectolitres, (a hectolitre is 22·009,668 gallons) and they employed 3,870 workmen, namely, 1 300 French Miners, 120 Belgian ditto, and 1,150 dragsmen and pitmen. The Loire coal basin centres Saint Etienne and Rive-se-Gier Culm for smithies, ditto more compact, fit for the fire-grate. Environs of Brassac in the Aveyron, good qualities for the grate; Canal du Centre principal mining points, those of Treuzot and Blangy, furnace and for coke; Monceau, (adjoining Blangy) vertical coal beds, fit for furnaces but not for coke. Decise mines near the Loire, lasting in the furnace. Fans in the "Allier" mines, quality of coal equal to St. Etienne, for forge furnaces; Commentary in same department, coke for railways. Epinae in department of Soanvet Loire, fierce coal for furnaces, but more clinkey than that of the Loire. Alais Deeageville and Carman mines, coal good for smelting-works, foundries, &c., these mines give 120,000 tons a year; but with improved machinery, this amount might probably be raised to 300,000 tons. Graissesac basin, north of the department of Heranet, its coal fields touching the department of Farn and Aveyron; in extent about 80 kilometres square, or 1000 hectares; general tonnage of the basin including loss by faults, &c., 85,141,300; or what would give 600,000 tons per year, for 140 years.

An Explosion of Fire-Damp took place 26th September ult., at the colliery of Messrs. Knowles and Hall, Bank Top, near Bury, Four men dreadfully burnt, recovery doubtful.

The Recent Discovery of Coal near Dover is considered as of great importance. While the workmen employed on the London, Chatham, and Dover Railway were engaged in tunnelling, between Lydden Hill and Shepherds well, a few miles from Dover, they came upon a fine seam of coal. The more the seam is entered upon the better becomes the quality of the coal.

Port Philip and Colonial Gold-Mining Company.—Quartz crushed during the 4 weeks in June last, 1,712 tons; yielding 1,735 oz. 11 Cwt. of gold.

Clunes now working satisfactorily by the new arrangement with the above company; in consequence, the Clunes Company have decided to sink a new main shaft of larger dimensions than the one now in use, to be sunk ultimately to 100 fathoms. Crushing capabilities now about 500 tons per week.

English and Australian Copper Company.—5 furnaces at work (15 July ult.,) Make of copper to 32th June 2,298 tons; a shipment of 53 tons of copper had been made to London, instead of India, owing to the large quantity being shipped to that market.

Coal in Belgium.—With exception of England, no country is so richly provided with coal as Belgium, It is found in 3 districts (those of Mons, Charleroi, and Liege) which contain 304 miners, thus divided:—Mons, 69; Charleroi, 85; Namur, 38; Liège, 88; Huy, 24. The extent of the coal fields is 150,000 hectares, or 370,671 british acres; a hectare being 2·471,143 acres.

At the Clyde Iron Works, Scotland, the miners to the number of between 300 and 400 who have for some time past been out on strike for 6d. per day advance of wages, have resumed work; their employers the Messrs. Dunlop, having acceded their demand.

The Coal Supply to the Metropolis by rail for the 3 months ending 1st of October ult., was 264,495 tons, 2 cwt. of which the London and North Western portion was 114,956 tons 5 cwt.; the Great Northern 91,184 tons 6 cwt; Eastern Counties 23,326 tons, 17 cwt; Great Western 20,193 tons; Midland 8,587 tons; South Western, Tilbury and Southend 293 tons. Taking the whole year up to the 1st October, there was a decrease as compared with same period of 1858, of 10,599 tons 14 cwt., the traffic being for 1858 857,149 tons 9 cwt.; and for 1859 846,549 tons 15 cwt.

Coal in Africa.—Recent official notices, by Dr. Livingstone, of his exploring expedition up the Zambesi, establish the fact, that near the rapids of Kehra, or more correctly Kaord Vasa, there are (geologist's report), 3 seams of coal, 1st 7 feet thick; 2nd 13 feet 6 inches; 3rd 25 feet thick, in a fine Cliff section. It was fired by lightning, a few years ago, and burned a long time.

In Algeria, the French Mines at Mazig have been set fire to by the Moors (of Morocco), in an attack made on the neighbouring towns. The French authorities have established a garrison at the Mines of Gar Rouhan.

Of the French Coal-basins, the most important is that of the Loire, reposing on a primitive formation, and divided into 2 portions, the centres of which are Saint Etienne, and Rive de Pier. The area is 200 square kilometres. Mean thickness of the beds, from 1, to 5 or 6 metres, furnishing 2 varieties of coal:—one culm, for smithies, of the best quality; the other, more compact fit for the fire-grates. The others are:—Valenciennes, a prolongation of the Mons Basin, in Belgium. Strata, from 50 to 100 metres in thickness; maximum thickness of beds, about 0m. 70c., covering a little more than 2 feet 3½ inches.

The Quesnats (otherwise Canal) River Gold-Fields, British Columbia. This late discovery is confirmed. The Quesnats, (corrupted into Canal) River, is far up in the interior, and a tributory of the Fraser, into which it falls about 30 miles north-west of Fort Alexander, one of the Hudson's Bay Company's stations, on the southern confines of New Caledonia district. These Mines are about 500 miles distant from Victoria, and are the extreme point to which the Miners have penetrated. The last accounts of the yield are 30 dollars a day to the man, while some reach 200 dollars. The "dirt" is said officially to average 50 to 60 cents. to the pan. A party of 3 Germans had taken out 6000 dollars in less than 40 days.

Another [British Columbian] Gold-Field has just been discovered on Bella Coola River, on the coast some 330 miles north of Fraser River.

Of the Fraser River Gold Mines, the good accounts are corrobated by Mr. Begbie, the Judge of British Columbia, who had returned from his circuit in the interior.

A Coal Pit on Fire.—From the upcast shaft of the Mosbro' Moor Colliery, Derbyshire, 8th September ult., about 3 p.m., smoke was observed to be issuing. Through the shaft, the hands are drawn up; it could not, therefore, be used as means of exit, as it was full of smoke. The downcast, or pumping-shaft, used for purposes of drainage, (depth 160 feet, and passage obstructed by piping and gear), had consequently to be resorted to. By means of a gin and pulley, several men descended the pit to the rescue. Up to half past 10 at night, about 14 persons had been drawn up, the fire still raging, 4 had perished.

Chili.—A very rich Copper Mine has been discovered, near the Port of Pan de Azucar, to the north of Chanaral de los Animas.

A Serious Accident in Blasting occurred recently at the Camperdown Quarries, near Lochee. In blasting, one of the charges did not explode. Two of the men engaged in the works endeavoured to abstract the charge and renew it. Whilst doing so, the powder exploded, injuring them exceedingly. The face of one man was almost entirely blown away, both arms fractured, and the right hand blown off. His companion was also badly hurt by the explosion.

The Collier's Strike at Wrexham is still pending. A large open-air meeting of colliers has been held on the Wrexham Race-course, which resulted in demanding a rise of 4d. per day, and a deputation was appointed to wait upon a meeting of employers at Brymbo to submit this proposition, which was a reduction of 2d. per day on their previous demand (6d. per day.)

A Mining and Engineering College is about to be established in connection with the University of Durham, and with preparatory schools to be set on foot throughout the different mining and colliery districts of the United Kingdom, for the practical training of boys as managers of mines, or as engineers for manufacturing pursuits. Matriculated Students to be admitted to the academical rank of "Mining Engineer," and "Civil Engineer." For this step in the right direction, we are indebted to the recommendations in the Report of Mr. Tremenheere, Mining District Commissioner, recently addressed to the Home Secretary. Similar training classes are also to be engrafted on the Bristol Diocesan School, as likewise in Lanarkshire and Ayrshire.

Gold in British Columbia.—By late advices, an expedition recently left Victoria for Queen Charlotte's Island, to search for gold.

Copper in Japan.—By recent advices per China Mail, the American Consul and the Japanese Government had amicably settled a mining misunderstanding. An American, who had discovered a rich copper mine, laid claim to the mine, and to the soil, contrary to the laws of the country. The Government resisted the claim. After some rather warm discussion, the author of the discovery gave up his claim on the soil, and solicited authorisation to work the mine, and share the profit with the Japanese Government, the offer was at once accepted. The Emperor's moderation in the case is highly spoken of.

WATER SUPPLY.

Metropolitan Waters.—The official table of analysis (Registrar General's Report) contains one item of comparative salubrity of various metropolitan waters well deserving attention. It is that of a well in Camberwell, one of the shallow wells of the metropolis, which are all contaminated with sewage matter, and have been proved, in many instances, to be injurious to health. The analysis gives of total impurity per gallon, in grains or degrees, 62·67 and of organic impurity, in grains or degrees, 10·69.

The Shepton Mallet Waterworks are progressing. The whole of the pipes are laid down, from the spring to the tank, and from thence nearly to the town leading to the railway station. The better class of houses are having the pipes laid to them, many in the bed-rooms.

At Lyons the pipe from the Reservoir, always kept full at the top of the Theatre' as a resource in case of fire, burst during the performance, and a deluge of water in consequence inundating the stage, it was found necessary to stop the performance for the night.

An Artesian Well, nearly 2,600 feet deep, has been sunk at a Sugar Refinery in St. Louis Missouri, U.S.

APPLIED CHEMISTRY.

For rendering Cloth, &c., Waterproof, but without impeding perspiration, M. Thireux's new and simple process, now adopted in France, consists in immersing the tissue to be "impermeabilised" for 4 hours, in an aqueous solution of acetate of alumine. The textile fabric, thus treated, becomes impermeable to water, but permeable to air; retaining at the same time, all its original qualities of suppleness, evenness of texture, and uniformity of external appearance. Several of the Railway Companies have supplied their employés with dresses made of cloth so prepared.

Leather Tanning.—M. Walti, in the *Technologiste*, recommends to Tanners the use of Creosote, mixed with soft water, as a a means of counteracting the effects of putrid fermentation, during the process of converting the raw hides into leather; as likewise of the plants, great Pimprenel, (sanguisorba officinalis), and Bistorte, (Polygonum bistorta), indigenous to various localities, the roots of which as containing more "tanin" than do the best of the Oak-barks, are peculiarly adapted for the use of the Tanner.

Artificial Rose-Water is thus produced, by Professor Wagner. It is well known to chemists, that the decomposition of the *Salycilate of Potass* is accompanied by a very decided odour of roses. This salt is obtained by boiling a solution of Potass mixed with the volatile oil of *Gaultheria procumbens*, obtainable at a cheap rate in commerce. The mother-water from which the crystalline mass has been allowed to subside, has a strong odour of roses, and from it, by distillation with water, an artificial rose-water is obtained.

LIST OF NEW PATENTS.

2061. F. Carpenter, Porter-street, Westminster—Apparatus for cutting tobacco.
2063. S. Cornely, Lime-street—Permanent way of railways.
2060. S. Worssam, Chelsea—Sawing machinery.
2062. W. E. Gedge, 4, Wellington-street South, Strand—Manufacture of nails.
2064. A. V. Newton, 66, Chancery-lane—Machinery for manufacturing hat bodies.

Dated 10th September, 1859.

2065. H. O. Robinson, Westminster—Manufacture of sugar.
2067. J. Pollock, Leeds—Manufacture of beds, couches, and invalid or other carriages.
2066. A. Smith, Mauchline, Ayr, N.B—Strengthening umbrella and walking stick handles.
2068. W. Ross, Glasgow—Apparatus connected with the discharge of liquids.
2069. E. J. Mallet, New York—Axles.
2070. T. J. Perry, Bilston, Staffordshire—Construction of hot air oven.

Dated 12th September, 1859.

2071. T. G. Gutch, Southampton—The improvement of copying books, for order and letter books.
2074. H. W. Ripley, Bradford—Finishing dyed piece goods.
2075. F. Heindryckx, Brussels—Railways or tramways.
2077. F. Versmann and A. Oppenheim, Bury-court, St. Mary Axe—Treatment of various substances, so as to render the same non-inflammable.
2079. F. N. Gisborne and L. S. Magnus, 3, Adelaide-place—Telegraph cables.
2081. H. G. Collins, McLean's-buildings, New-street-square—Producing printing surfaces on stone.
2076. J. Eason, Oxford-street—Buff or losh and oiled leathers.
2078. W. H. Morrison, Nottingham—Bonnet and cap fronts.
2080. J. Mason, Birmingham—Boxes or cases and cards to contain or hold pens.
2082. W. Elliott, Birmingham—African or Guinea rods.

Dated 13th September, 1859.

2085. G. M. Levi, Val Benoit, Liege, Belgium—Washing and separating ores and substances of different specific gravities.
2087. J. Grainger, Birmingham—Breech-loading firearms.
2088. A. B. Freeland, Camden-road Villas, Middlesex—Preparing hay and clover for food for horses.
2089. W. E. Newton, 66, Chancery-lane—Apparatus for drying paper and other fabrics.

Dated 14th September, 1859.

2090. S. Hecht, 36, Gresham-street—A new mode of advertising.
2091. C. G. Gumpel, 2. Gordon-cottages, Holland-road, Brixton, Surrey—Application of motive power to the propelling of vessels.
2092. J. Marritt, Sutton, Yorkshire—An improved double-action rotating harrow.
2093. Lieut.-Col. J. P. Kennedy, Torrington-square, Middlesex—Steam boilers.
2094. R. C. Rapier, Newcastle-upon-Tyne—Construction of steam boilers.
2095. C. Beslay, Rue St. Sebastian, Paris—Preparing and obtaining printing surfaces with designs sunk as also in relief.
2096. N. Defries, 5, Fitzroy-square, Middlesex—Gas meters.
2097. J. S. Slocum, Providence, Rhode Island, U.S.—Projectiles suitable for ordnance.
2098. E Applegath, Dartford—Machinery for printing and for cutting printed paper into sheets.

Dated 15th September, 1859.

2099. J. Robinson, Sutton, near Hull—Agricultural implement.
2002. J. K. Watson, Edinburgh—Gas meters and exhausters.
2004. W. Clough, Wigan, Lancashire—Apparatus for propelling vessels on water.
2006 W. A. Turner, Manchester, and H. L. Lilley, Standlane, Manchester—Starch.
2008. J. F. F. Leroux, 29, Boulevard St. Martin, Paris—Apparatus to be employed for taking money ou the counters.
2009. T. Hedgcock, Ivy-cottage, Great Church-lane, Hammersmith—Quadrants.
2010. J. Spurgin, Great Cumberland-street, Middlesex—Ordnance and projectiles.

Dated 3rd September, 1859.

2018. G. Parsons, Martock, Somersetshire—Wheels.
2020. H. Swan, 5, Bishopgate street Without—Stereoscopes and stereoscopic pictures.
2014. W. Suffield, Birmingham—Artificial teeth.
2016. G. Davies, 1, Serle-street, Lincoln's-inn—Printing.

Dated 5th September, 1859.

2022. F. C. Bakewell, 6, Haverstock-terrace, Hampstead—Caustic alkalies.
2024. J. B. H. H. R. Barre, and J. B. M. E. Barre, Paris—Engraving metals and their alloys.
2026. W. L. Earle, Alfred-place, Bedford-square—Apparatus for promoting the combustion of smoke from fuel.
2028. A. V. Newton, 66, Chancery-lane—Sewing machines.

Dated 6th September, 1859.

2030. G. Lowry, Salford, Lancashire—Machinery for heckling flax.
2034. A. V. Newton, 66, Chancery-lane—An improved fabric, applicable to the manufacture of hose or flexible pipes.
2036. E. Blake, 61, Tachbrook-street, Pimlico—Apparatus for treating China-grass rhea.

Dated 7th September, 1859.

2038. E. R. Dann and E. Goldschmidt, Nottingham—Bonnet fronts or lappets.
2040. H. Jones, Birmingham—Breech-loading firearms.
2042. J. L. Jullion and G. Pirie, Aberdeen—Gelatine.
2044. A. V. Newton, 66, Chancery-lane—Metallic strips.
2048. W. Rothwell, Carr House, Midgley, Halifax, and T. Watson, Midgley—Screw gill-boxes.

Dated 8th September, 1859.

2049. T. Hoodman, 490, Oxford-street—An improved stock.
2051. J. Nicholson, Chaple House, Hensingham, Whitehaven, Cumberland—Horse rakes.
2053. J. Thorley, Newgate-street—Food for cattle and horses.
2055. T. W. Allsopp, Castle Donington, Leicestershire—Portable gas apparatus.
2050. T. O. Small, Newcastle upon-Tyne—Stereoscopes.
2052. J. H. Johnson, 47, Lincoln's-inn-fields—Cocks and valves.
2054. J. Tandy, Cavendish-grove, Wandsworth-road, Surrey—Locomotive and other steam boilers.
2056. G. Gowland, Liverpool—Nautical and surveying instruments for measuring angles.

Dated 9th September, 1859.

2057. W. Roscoe, Croxteth Hall, West Derby, Lancashire—Machine for distributing guano and other manures upon land.
2058. M, M. Jackson, Zurich, Switzerland—Generating steam for condensing engines.
2086. E. A. F. Lebourgeois, Suresnes, France—Providing with pin points the blocks employed for surface printing on calico.
2059. J. G. N. Alleyne, Butterley Iron works, Alfreton, Derbyshire—Manufacture of wrought-iron beams.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 20th June, 1859.

1478. L. D. Dewey, 4, Southampton-buildings, Chancery-lane—Spring seats for chairs.

Dated 4th July, 1859

1589. H. C. Howells, 120, Duane-street, New York, and J. C. Howells, Madison, U.S.—Registering the number of persons entering or leaving public conveyances.

Dated 26th July, 1859.

1739. D. B. Hale, New York, U.S.—A new and useful garment for ladies' wear.

Dated 6th August, 1859.

1813. A. S. Stocker and G. J. Farmer, Birmingham—Boots and shoes.
1814. C. C. R. Goudenove and A. Feret, 60, Rue Neuve St. Augustin, Paris—Gas burners.

Dated 9th August, 1859.

1842. F. L. Lawrence, 50, Berners-streeet, Oxford-street—Hardening elastic gums for dental purposes.

Dated 16th August, 1859.

1886. W. Leatham, Leeds—Double acting superlative screw throttle valve.

Dated 22nd August, 1859.

1910. J. Gregory, Barreiro, Portugal—Locomotive and other steam engines.

Dated 27th August, 1859.

1957. J. Philp, Camden-town, Middlesex—Manufacture of soap.

Dated 29th August, 1859.

1959. J. Whitworth, Manchester—Ordnance, fire-arms, and ammunition.
1964. J. Edwards, 77, Aldermanbury, London—Manufacture of buttons.

Dated 30th August, 1859.

1970. J. H. Johnson, 47, Lincoln's-inn-fields—Construction of steam generators.
1972. G. Collier, 23, Elizabeth-street, Eaton-square—Chairs and couches.
1974. J. Field, Lambeth—Superheating steam.
1976. H. Hutton, Palace-road, Lambeth—Lubricator.

Dated 31st August, 1859.

1978. J. Cowgill and J. Stocks, Bradford—Caps for spinning fibrous substances.
1980. W. A. Von Kanig, Hardinge-street, Islington—Manufacture of starch and compounds of starch.
1984. J. Mackenzie and T. Wentworth, St. Martin's-le-Grand—Breech-loading fire arms.
1986. J. Samuel, Great George-street, Westminster—Railway sleepers.
1987. H. Higgin, Bow, Middlesex—Machinery for cutting and preparing match splints.
1988 L. Berge, Newgate-street—Fastening or securing portemonnaies.
1990. E. Ellis, St. Ann's Well-road, Nottingham—Finishing silk fabrics made on bobbin net, and warp frames.
1989. R. A. Brooman, 166, Fleet-street—Treating auriferous and argentiferous ores and substances.

Dated 1st September, 1859.

1992. J. Brine, Maidstone, Kent—Combining the leaves of books to be used for producing simultaneously one or more fac-simile copies of letters.
1996. J. Borrington, Derby—Pumps.

Dated 2nd September, 1859.

1998. P. Wright, Dudley, Worcestershire—Manufacture of anvils.

2100. J. Addenbrooke, London—An apparatus for wrapping, folding, or packing up goods or parcels.
2101. J. Brière, Brussels—Railway breaks.
2102. J. T. Wood, Strand, Westminster—Printing and embossing dies.
2103. H. Winter, Albion-terrace, Hackney, Middlesex—Apparatus for lifting and weighing loaded sacks.
2104. J. P. Clarke, King-street Mills, Leicester—Manufacture of spools or reels for the winding on of cotton, thread, or other fibrous materials.

Dated 16th September, 1859.

2105. J. W. Hadwin, Kebroyd Mills, Halifax—Machinery for drawing fibrous substances in any of the processes or machines for preparing to be spun.
2106. J. Bottomley and A. H. Martin, North Brierley, near Bradford, Yorkshire—Apparatus employed in weaving.
2107. N. Heckford, Forest Gate, Essex—Purifying the Thames and other rivers.
2108. B. Lauth, Manchester—Rails for railways.
2109. W. E. Newton, 56, Chancery-lane—Machinery for forming hat bodies.
2111. H. Jackson, Oak-lane, Limehouse.—Fire bars.
2112. J. Beck, Coleman-street, London—Stereoscopes.

Dated 17th September, 1859.

2113. J. Luis, 1B, Welbeck-street, Cavendish-square—A new brick and tile making machine.

Dated 18th September, 1859.

2114. J. Luis, 1B, Welbeck-street, Cavendish-square—Mechanical hammers.
2115. J. Luis, 1B, Welbeck-street, Cavendish-square—Brakes for railway carriages.
2116. J. Luis, 1B, Welbeck-street, Cavendish-square—An automaton bell for the prevention of collisions at sea.
2117. J. Luis, 1B, Welbeck-street, Cavendish-square—A slip bridle for stopping runaway horses.
2118. J. Luis, 1B, Welbeck-street, Cavendish-square—Cooling apparatus for liquids.
2119. J. Luis, 1B, Welbeck-street, Cavendish-square—An improved disc and lantern signal with double repeaters.
2120. J. J. Kerr, Twickenham, Middlesex—Cartridges containing shot.
2121. S. N. Rodier, Prospect-cottage, Stand-on-the-Green, Chiswick, Middlesex—Regulation of gas to burners.
2122. T. Elliott, Manchester—Lubricators.
2123. A. J. Norman, Gore-lodge, Turnham Green, Chiswick Middlesex—Paving roads and surfaces.

Dated 19th September, 1859.

2124. E. H. Taylor, Saltney, Chester—Mode of securing the bolts in fish-joints.
2125. F. N. Gisborne, 3, Adelaide-place, London Bridge—Paying out submarine telegraphic cables..
2126. J. Hawkins and C. Hawkins, Walsall—Fly presses to be worked by steam.
2127. W. Robertson and J. Tweeddale, Johnstone, Renfrew, N.B.—Hydrostatic jacks, or lifting apparatus.
2128. R. McCall, Dublin—Obtaining precipitates of copper.
2129. J. Wright, 42, Bridge-street, Blackfriars—Construction of carriages, coaches, omnibuses, and other such like conveyances.
2130. T. C. Eastwood, Bradford—Apparatus for preparing and combing wool.
2131. P. Fairbairn, Leeds—Improved machinery for finishing the teeth of spur and other gearing.
2133. R. A. Brooman, 166, Fleet-street—Elevators or lifts, for hotels, warehouses, and other structures.
2134. W. Clar, 53. Chancery-lane—Electro magnetic telegraphs.
2135. L. Engler and E. F. Krauss, 29, Boulevard St. Martin, Paris—A new or improved system of insulators for electric wires.
2136. J. Court, Brompton-row, Middlesex—Imp. applicable to gas lamps for effecting more complete combustion therein.

Dated 20th September, 1859.

2137. A. Manbré, 10, Rathbone-place, Oxford-street—Colouring matter for colouring spirits, and other liquids.
2139. W. Weild, Manchester—Fluted rollers, used in machines for preparing, spinning, and doubling fibrous materials.
2140. W. McIlwraith, Glasgow—Weaving.
2141. J. Beads, Pendleton, near Manchester—Apparatus for spinning fibrous substances.
2142. A. Lamb, Southampton—Heating the feed water for boilers.
2143. W. E. Newton, 66, Chancery-lane—Projectiles.
2145. E. Collier, Myddelton-street, Clerkenwell—Ear dilators.

Dated 21st September, 1859.

2147. H. Corless, West Derby, Lancashire—Apparatus for washing, wringing, and mangling.
2148. H. A. Jowett, Sawley, Derbyshire—Breaks for railway carriages.
2149. J. Blair, Manchester—Treatment of yarns during the operation of spinning.
2151. W. E. Newton, 66. Chancery-lane—Apparatus for condensing the waste steam of marine engines.
2152. R. Davison, London-street, London—Holders for containing liquids.
2153. J. Harrison, Glossop, Derbyshire—Spinning mules.

Dated 22nd September, 1859

2155. T. Field, 5, Rose-gardens, Hammersmith—System for cleaning, pressing, and glazing laundry work and textile fabrics generally.
2156. R. B. Mowbray and T. Coatman, Manchester—Steam boilers and heating apparatus.
2157. J. Dales, 11 and 12, Gresham-house, Old Broad-street, London—Purifying sewage and other impure waters.
2158. E. Jones, Dudley. Worcestershire—Manufacture of coke in open coke fires.

Dated 23rd September, 1859

2160. C. J. Parry. Manchester—Sewing machines.
2161. C. J. Parry, Manchester—Diamond shirt fronts.
2159. L. Castelain, 53, Newman-street, Oxford-street, and C. F. Vasserot, 45, Essex-street, Strand—Application of a plant to the manufacture of pulp for paper and millboard.

Dated 24th September, 1859.

2162. T. Bentley, Margate, Kent—Agricultural implements.
2163. J. J. Bourcart, Manchester—Apparatus for opening, cleaning, and drawing cotton.
2164. R. James, Manchester—Apparatus for covering crinoline.
2165. A. R. Le Mire Normandy, 67, Judd-street, Brunswick-square—Application of steam for cooking food.
2166. J. Gedge, 4, Wellington-street South, Strand—Stamp holder and cutter,
2167. C. Lambert, Sunk Island, Yorkshire—Apparatuses for cutting and pulping food for cattle and other like purposes.
2168. J. Coey, Liverpool—Packages for containing butter.
2169. T. Robinson, St. Helen's, Lancashire—Steam hammers.
2170. T. B. Daft, Tottenham, Middlesex—Coating metal conductors.
2171. J. T. Pope, Burslem, Staffordshire—Marbles.
2172. J. Todd, Greenwich—Screw propellers.
2173. J. Opie, Tremar, Cornwall—Charging holes in blasting operations.

Dated 26th September, 1859.

2174. J. Fernihough, Dukinfield, Chester—Pistons, plungers, and buckets.
2175. R. W. Sievier, Upper Holloway, Middlesex—Means of creating a draught, so as to remove the gases which may be produced by combustion.
2177. D. White, 18 High Holborn—Increasing the illuminating and heating powers of gases..
2179. J. Villet-Collignon and L. George, Paris, 29, Boulevard St. Martin—Typography.

Dated 27th September, 1859.

2181. W. Airey, Brighouse, and J. Clayton, Golcar, Yorkshire—Apparatus for preparing silk, or other fibrous substances for spinning.
2182. R. Coales, 53, Chancery-lane—Preparation for promoting the growth of the hair.
2183. T. Birtwell and R. Marshall, Padiham, Lancashire—An improved arrangement of apparatus to facilitate the putting on of boots to the feet.
2184. C. Cowper, 20, Southampton buildings, Chancery-lane—Combining and deodorizing oil made from gas tar and other oils.
2185. J. S. Parfitt, Paris, 60, Boulevard de Strasbourg—Machine for heading bolts, rivets, screws, and other articles requiring to be headed whilst hot.
2186. J. R. Piednue, Royal Mint Refinery, Royal Mint-street, Middlesex—Apparatus for transmitting motive power.
2187. T. Beards, Stowe, Buckinghamshire—Ploughing and cultivating land by steam power.

Dated 28th September, 1859.

2188. P. J. Lejeune-Chaumont, Faubourg Vivegnies, 138, Liége—Fire-arms and ordnance, and projectiles and cartridges to be used therewith.
2189. W. Maltby, De Crespigny park, Camberwell—Starch-gum.
2190. W. Collins, Salford, Lancashire—Stand pipes for hydrants.
2191. E. K. Dutton, Sale, Chester—"Governors" adapted to steam engines.
2192. W. J. Dorning, Manchester—Traction engines.
2193. T. Sutton, St. Brelade, Jersey—Apparatus for taking photographic pictures.
2194. E. S. Cathels and S. Splatt, Dover—Gas meters.
2195. W. H. Phillips, Nunhead, Peckham, Surrey—Apparatus for generating and regulating heat.
2197. G. Evans and E. Huxley, 12, Old Cavendish-street, Cavendish-square, Middlesex—Construction of hernial trusses and pads adapted to surgical purposes generally.
2199. M. L. J. Lavater, Strand—Apparatus known as injection bottles.
2200. P. Robertson, Sun-court, Cornhill—Manufacture of manure.
2201. D. Stewart, Newcastle-on-Tyne—Presses used for pressing goods.

Dated 29th September, 1859.

2202. C. Stevens, 1B, Welbeck-street, Cavendish-square—Steam dredging boat.
2203. G. G. Page, Whitehall, and C. Lungley, Deptford, Kent—Gangways, applicable to floating bodies.
2205. W. Johnson, Horse Shoe-court, London—Purses.
2206. E. H. Bentall, Heybridge, near Maldon, Essex—Screw presses.
2207. C. Duplomb, Rue de Rivoli, No. 112, Paris—Presses for pressing textile fabrics.
2208. A. W. Williamson, University College, and L. Perkins, Francis-street, Gray's-inn-road—Steam boilers.
2209. W. Kempe, Holbeck Mills, Leeds—Machinery for raising the pile of woollen and other cloths.
2210. R. Oxland, Plymouth—Treatment of saccharine matters.

Dated 30th September, 1859.

2211. J. Wadsworth, Manchester—Instruments or apparatus for measuring, regulating, and controlling gas used for purposes of illumination, and gas burners.
2212. T. Guibal, Hainaut Mines, Mons, Belgium—Cables used in springing up mines.
2213. W. Hartley, Bury, Lancashire—Steam engines.
2215. T. Buckham, Gloucester—Switches for railways.
2216. J. O. Smith, 18, Warwick-court, Gray's-inn—"Perambulators."
2217. B. Atkinson, Rainham, Essex—Railway brakes.
2218. W. H. Buckland, Maesteg Iron Works, Glamorganshire—Preparation of peat.
2219. W. H. Hart, Fleet-street—Argand and other gas burners.
2220. W. Clark, 53, Chancery-lane—Railway signal apparatus.
2221. J. H. Johnson, 47, Lincoln's-inn fields—Reworking the waste steam of steam-engines.
2222. M. and A. Samuelson, Scott-street Foundry, Hull—Planing, slotting, and grooving machines.
2223. Hon. W. E. Cochrane, Osnaburgh-terrace, Regent's-park—Apparatus for receiving and securing the ends of the rails of railways.
2224. W. V. Edwards, Swindon, Wiltshire—Apparatus to facilitate the conveyance of mails, goods, and passengers.

Dated 1st October, 1859.

2226. W. Parkin, Sheffield, and J. Bates, Hyde, Chester—Wedges for railway chairs.
2229. R. A. Brooman, 166, Fleet-street—Furnaces employed in the manufacture of iron.
2231. J. Millar, Edinburgh—Reflectors for diffusing artificial light.
2232. L. Newton, Oldham, and J. Greaves, Staleybridge. Lancashire—Cop tubes or spools, and machinery for manufacturing the same.
2233. G. Bridgett, Pilcher-gate, Nottingham—A new mode or method of manufacturing Shetland or other falls from the stocking-frame.
2234. J. Wright, Teesdale Iron Works, South Stockton, Yorkshire—Apparatus for raising water and minerals from mines.

Dated 3rd October, 1859.

2235. E. Morewood, Enfield, Middlesex—Coating metals.
2237. L. H. I. Lemaire, Stamford-street, Blackfriars—Manufacture of chenille.
2238. W. R. Earle and E. J. Barnes, Queen's-terrace, Queen's Head-lane, Islington—Photographic and other portraits.

Dated 4th October, 1859.

2239. G. F. Greiner, 57, Wells-street, St. Marylebone—Pianofortes.
2240. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Coupling joint for pipes or tubes of soft metal, caoutchouc, gutta-percha, or other yielding matter.
2241. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—"Porte-jupe," or apparatus for suspending dress-skirts and other objects.
2242. J. Loftus, Elton-Fold, near Bury, Lancashire—Machinery for combining and carding cotton or silk and wool.
2243. R. and W. Hollis, High Coggs, Witney, Oxfordshire—Apparatus for winnowing and dressing grain.
2244. S. R. English, Birmingham—Apparatus for taking copies of writing.
2245. R. Brearley, jun., Batley, Yorkshire—Apparatus for raising the nap or pile of cloths.
2246. W. Backett, Old Kent-road, Surrey—Cleansing powders.
2247. W. E. Newton, 66, Chancery-lane—Apparatus for generating steam.
2248. J. M. Rose, R. Carte, and W. Pikesley, Charing-cross, Westminster—Drums.

Dated 5th October, 1859.

2251. J. Thompson, Witton, near Northwich, Cheshire, and J. Thompson, Castle, Northwich—Manufacture of salt.
2253. A. Whytock, 12, Little St. Andrew-street, Upper St. Martin's-lane—Applying joined sheets of metal for roofing and other purposes.
2255. J. Shields, Perth, N.B.—Jacquard looms or machinery for weaving.
2257. J. J. Eagleton, Birmingham—Annealing furnaces.
2259. G. Davies, 1, Serle Street, Lincoln's-inn—Apparatus for vaporizing liquids and heating air.
2261. J. Scott, Sunderland—Manufacture of anchors.
2263. W. E. Newton, 66, Chancery-lane—Revolving fire-arms.
2265. W. L. Earle, Alfred place, Bedford-square—Combustion of smoke and gases arising from fuel.
2267. J. Macintosh, North Bank, Regent's-park—Manufacture of flexible tubes.
2269. J. Macintosh, North Bank, Regent's-park—Coating metallic conductors for electric telegraphs.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2154. E. B. Dimock and J. H. Baker, Ware House Point, Connecticut, U.S.—Apparatus for drying woollen or other cloths.—21st September, 1859.

THE ARTIZAN.

No. 203.—Vol. 17.—DECEMBER 1st., 1859.

STEAM ENGINEERING IN 1859.

Recapitulation: Concluding Remarks.

The first paper of this series appeared in the May numher, and was ntended to point out the avoidahle difference, existing hetween the present practice of steam engineering, and that, which if generally adopted, would result in many and undouhtahle advantages.

It was intended also to indicate that steam engineers were practically neglecting to appreciate thc only true principles in steam engineering, on which all economy must rest, and that with few exceptions, we are literally wasting money aud time, by allowing the manufacture of steam engines to degenerate into a mere trade.

During the past six months, several instances have occurred, in which the possibility of an indicated horse power being ohtained from the consumption of 2½ lhs. of coal, has heen more than verified and these instances have in many particulars, confirmed fully the truth of all we have stated in reference to the economy of steam power.

Paddle engines of considerahle power, are now regularly working with a consumption less than 2½ lhs. of coal per hour, and this is accomplished with all the disadvantages arising from the use of salt water. This creditable result is due solely to an intelligent appreciatiou, by the designer, of those truthful principles we have endeavoured to recommend.

In another case of recent improvements in steam power, hy an improved class of hoiler, the use of distilled water, conservation of heat, and extensive developement of the expansive principle, an indicated horse power has heen realized hy a consumption considerahly less than 2lhs., of coal per indicated horse power, per hour.

In another case with more limited expansion, and pure water for evaporation, the coal consumption has averaged for a considerahle period less than 2½ lhs. per indicated horse power, per hour.

The ahove cases in actual practice, are well authenticated, hut it is unnecessary to remind the practical reader, that, in the application of steam power, many conditions have to be fulfilled, hesides that of economising fuel; cost of construction, simplicity, safety, weight, space, durahility, have all to he separately considered; and the greater the change introduced, the longer the time required to test it, hefore it deserves the confidence of the puhlic.

To ensure the acceptance of our statements, even hy those most indisposed to wander from the heaten track, in all cases we have stated *less* than the truth; that is, present defects have heen leniently represented, and the advantage that may he obtained from attention to true principles of economy, have been underrated.

It must not be forgotten that the success of improvements, and more especially their general adoption, are greatly dependent on the moderation of the engineer who introduces them; many a fair and useful change has been kept in abeyance for years, by a want of moderation and judgment in the inventor. Experience teaches us that it requires more judgment to decide how and when to introduce an improvement, than it does to decide on the merits of the improvement itself.

In marine engineering, safety, and the greatest possihle freedom from risk, must be secured, even if necessary, at the cost of economy; and whoever introduces changes of a radical kind, incurs a heavy responsihility, and may, hy a want of prudence, he a curse to his patrons, and the profession: but this somewhat severe caution need not disturh or check the honest and earnest inventor; his success is certain, if he is moderate and *progressive.*

There are many good practical engineers and mechanics, hut few practical philosophers—we polish the shell hut waste the kernel—when shall we estimate the efficieucy of a steam engine hy the difference existing hetween heat expended and heat utilized? When shall we appreciate the vitality and importance of the true principles of economy, as distinct from mechanical construction? When shall we cease to sacrifice solid advantages, to apathy, ignorance, and trade puffery?

In the June numher, the generation of steam was considered, and we trust our readers will excuse our requesting particular attention to the statements made on that suhject.

Statistics emhracing a large field of ohservation have lately heen published, giving accurate information on the duty and economy of the Lancashire engines and hoilers, and we have the satisfaction of knowing that these statistics have most fully confirmed our own estimates, a matter of no slight importance, when it is rememhered that present duty must form the hasis from which all improvements spring.

A steam *engine* is attractive to the young steam engineer, but what does he care ahout the dirty hlack looking *boiler?* As a general rule (comparatively) he never takes any interest in boiler construction, until he is thrown on his own resources, when he is compelled to do so to maintain his credit and position; there are now hundreds of engineers holding important and responsihle positions, in positive ignorance of the laws that determine the economical efficiency of a steam boiler—dogmatism takes the place of knowledge, and we pick the fruit of such a state of things, in wholesale waste.

Perfect combustion is the starting point in steam generation, and thanks to the perseverance of some, earnest in their adherence to first principles there is a prospect of great improvement in the furnace arrangements of steam hoilers; but it is extraordinary what time it takes to convince engineers that it is impossible to ohtain a sufficient supply of air throngh the grate bars; or that perfect combustion is not attainable except at a very high temperature; and that space should he given to allow the air and gases to comhine.

The conversion of coal and air into an equivalent of heat, must he the first process—and then as the second process, that heat can he applied with full effect—but the custom is, hy low furnaces and contracted combustion chambers, to begin the second process before the first is half completed, the result being a certain loss.

With brick furnaces, a much less space for combination and combustion is sufficient, as the furnace case approaches in temperature that of the furnace itself, but with furnaces inside a steam boiler, it is quite different—the plates surrounding the fuel are always at a low temperature compared with that of combustion, and will, if in too close contact with the fuel, absolutely prevent the necessary temperature for perfect combustion ever being attained.

This is so self-evident that the present faulty construction of boiler furnaces is quite unaccountable.

In the boilers of the *Great Eastern*, it is quite evident that they were designed in improved accordance with the right principles of construction we have alluded to—the combustion space being in excess of the general practice.

In the June and July numbers, we pointed out the characteristics, of the wasteful and economical generation of steam, and as they are more neglected than any other connected with boiler construction, we must yet add a few more statements in illustration.

It must be allowed as undisputed that with an average rate of combustion, and a given class of boiler, a certain amount of heat-absorbing surface must be given, to take up the heat generated in the furnace, minus what is required for draft in the uptake—if this surface is not given, a certain amount of the heat is transferred from the water to the chimney.

Referring to the tables of ratios in the June number, we find experience fully confirms the fact stated above; and it will be found without a single exception, *other points of construction being similar,* the evaporative duty obtained from a pound of coal, is always proportionate to the ratio between the heating surface and the rate of combustion, a large ratio increasing, and a small ratio decreasing that duty.

It is matter of sincere regret, that we have to select as one of the most striking cases of a neglect of the above undeviating principle of economy, the boilers of the *Great Eastern.*

In February, 1855, the late Mr. Brunel reported to the proprietors of the Great Ship, that much attention had been paid to economy of fuel in the design of the boilers, and that to prevent a chance of error, an experimental boiler had been made. After such a report it might have been expected that a maximum evaporation would be obtained from the coal.

At pages 137 and 138, are given two experiments of evaporative duty in boilers of similar construction to those in the *Great Eastern,* except as to the ratio of heating surface to rate of combustion, which was in the first case 0·83 to 1, and in the second 1.9 to 1. The difference of evaporative duty in these boilers was nearly 40 per cent.

In the boilers of the *Great Eastern* there are only some 20 square feet of heat-absorbing surface to one square foot of fire grate, and with 100ft. height of chimney, and a high temperature in the uptake, there is every reason to believe, the furnance, when fully supplied, would consume *at least* 20lbs. of coal per square foot of fire grate, or 430 tons per day, and with dampers fully open, it is difficult to believe that less than 24 or 25lbs. of coal were burnt per square foot of fire grate; no practical man who has well considered the subject, can accept the statement, that when working the boilers at their full steaming power, the consumption of coal was only 309 tons a day, or 14lbs. per square foot of fire grate.

It is no matter of surprise that the water-jacket became a second boiler, for it is quite certain, with the deficient heating surface a high wasteful temperature in the uptake was inevitable.

The remedy in the case of the *Great Eastern* is to take away at least one third of the grate surface, and adopt some plan for preventing the loss arising from condensation in the cylinder—the result of such alteration would be a considerable decrease of the coal consumption and a considerable increase in the power of the engines and the speed of the ship.

In steam generation it is simply a matter of *choice* with the steam engineer as to what evaporative duty (within certain limits) he obtains from the fuel—shall it be 6, 7, 8, 9, 10, or 11 lbs. of water evaporated by a pound of coal? He can obtain either result without any radical change in the construction or form of boiler.

Before leaving the subject of steam generation, we must once more revert to the defective circulation of the water in marine and locomotive boilers. It is somewhat difficult to estimate the amount of loss incurred by deficient circulation, but there is no difficulty in proving that a considerable loss of evaporation is incurred, and also that another certain evil results—namely premature destruction of the conducting metal.

In the August number, the "the application of steam as a motive power" was considered; and the importance of maintaining the temperature of the steam in its passage to and through the engine, and of avoiding all premature condensation, was strongly represented.

The economy to be derived from the steam case or jacket round the cylinder is still disputed, but it is strange that, the bulk of the objectors to the jacket have in no case, made a fair comparison of economy by dynanometer or indicator, with, and without the jacket. Cornish engineers, object on account of the piston packing being affected by the heat given out by the jacket. To remedy this, the jacket was removed, and "they never noticed any increased consumption of coal." Most scientific conclusion, truly!!

In addition to the cases already given of economy derived from the application of steam-jackets, we may add two more. In each case the experiments were carefully made with and without the jacket. In the first case a saving of 27 per cent., was realised with the jacket, and the water condensed in it was less than 5 per cent. of the total quantity evaporated.

In the second case the saving was 22 per cent. with the jacket. The water condersed in it not being ascertained.

There are two points worth consideration in estimating the economy to be derived from steam jackets in condensing engines. The first is, that there is condensation only, and no re-evaporation in the jacket as in the cylinder. And secondly, that during half of each stroke the condensation in the jacket is practically uniform at all rates of expansion. It must also be borne in mind the re-evaporation that takes place during the exhaust stroke in the cylinder, not only robs heat from it, but requires increased duty from the condenser.

Superheated steam with an old boiler is often an evidence of original defective construction, but applied to a well designed new boiler, it has advantages difficult to obtain in any other way. Any plan by which a greater amount of useful effect can be derived from the heat generated in the furnace is a step in the right direction, and time and experience alone will prove what effect the highly heated steam has upon the working valve and cylinder surfaces.

There is a striking similarity in the amount of economy derived from the use of steam jackets, and that of superheated steam.

Without expansion, 40lbs. weight of steam will give an indicated horse-power; with an expansion of three times, or cut off at one fourth the stroke, 18lbs. weight of steam will give an indicated horse power, making no allowance for leakage or condensation. Supposing steam-jackets applied, and allowing one-fifth for condeusation, leakage, &c., and assuming 10lbs. of water to be evaporated by one pound of coal, and the steam to be expanded three times, *practically* an indicated horse power can be obtained by the consumption of 2¼lbs. of coal, just one half of the present average consumption, and this result can be realised without any great change in engine or boiler construction, and be it remembered when this improvement has been effected, we have only *began* to economize. As a commencement, an average of 2½lbs. of coal to the indicated horse power will be acceptable, and when that is accomplished, we shall find many pioneers doing the same duty with one pound.

As the indicator does not give us the power absorbed in friction, in and beyond the machine, it is impossible to use it in comparing the efficiency of two engines of a different class; for instance, a compound or Woolf-engine, having the same indicated power and consumption of coal as a single cylinder engine, would necessarily be the least efficient of the two from the increased friction.

The indicated power of the "*Great Eastern's*" engines has been published as 7600 when working full power, and consuming 300 tons of coal per day; this gives 3¾lbs. of coal per indicated horse power per hour; but for reasons we have given as to the evaporative duty of the boilers, and from the limited expansion employed, it is to be feared that at least 4½ or 5lbs are required per indicated horse power per hour; a most unsatisfactory result.

In some experiments with engines and boilers similar in proportion to those in the "*Great Eastern,*" 4¾lbs. of coal were consumed per indicated horse power per hour, working under favourable circumstances; and from the class of engines adopted for the screw, a less favourable result even than that referred to, must be expected from them.

It may be taken for granted that if there had been sufficient boiler power in the "*Great Eastern*" to indicate the anticipated 10,000 actual horse power, at least 500 tons of coal would have been consumed per day.

Notwithstanding the adoption, by an eminent firm, of trunk engines for screw propulsion, as simple and compact in a mechanical point of view, they are, by their very construction, and the cooling surface exposed inadmissable as economical engines; and, when we practically recognize the truth, that economy of fuel is the great desideratum, this description of engine will be as neglected as it deserves to be. For naval purposes, horizontal engines with double piston rods are almost equally compact with the trunk, and can be worked with very much less waste of fuel.

Reformation always springs from the people; as in politics and religion, so in science, those, high in professional position, are too often only the remote followers, and not, nay never, the pioneers, or even the encouragers of improvements.

To which of our great engineering firms, is steam engineering indebted for a due attention to economical principles of construction? Do they not in daily practice ignore the existence of power in heat?

Strange, but most true is it, that the highest price is often given for steam machinery, in the arrangement of which, there has been the least attention paid to economical efficiency.

We are loth to believe that the value of a steam engine is to be regulated solely by the excellence of its mechanism and workmanship.

It is quite certain that our government through its engineering officials, has been instrumental, to an alarming extent, in repressing improvement, and encouraging the "let alone" system in the steam machinery of the navy.

A few fortunate inventors, by, (to them,) an age of perseverance, and a determination not to be discouraged by any amount of official ignorance and red tapeism, have succeded in obtaining a fair trial of their inventions; but most men who have matured improvements, will not subject themselves to the uncertainty of governmental patronage.

For instance, if an engineer succeeds in reducing the present consumption of fuel by some well proved improvements on boilers or engines, he dare not submit his plans to the Admiralty, because he knows too well the jury that will have to give the verdict; and if the great contracting firms, who supply Government with marine engines of the old wasteful type, should disapprove his new plans, where is there a court of appeal? He is forewarned by the experience of others, that the chances are 100 to one against him.

Better days may, and they assuredly will come, when all who are competent, will be allowed to compete for Government orders, and at the present moment the list of privileged firms is being wisely extended.

It would be difficult to estimate the advantage to the country of offering a premium for the best arrangement of steam machinery for the gunboats; they are used in a service that requires them to have the following qualifications; *First,* to be easily concealed from the sight or hearing of the enemy; *Secondly,* to go the greatest distance with the least weight of fuel; *Thirdly,* to require a minimum amount of repair; and *Fourthly,* to be able to raise steam at the shortest notice: these are the requirements of the service they are built for. How are they fulfilled?

1. They have a puff blast in the chimney, to attract the sight and hearing of the enemy.

2. They are wasteful on fuel, and go the least possible distance with a maximum consumption.

3. They require more decided extensive and constant repair than any other class of machinery in Her Majesty's Steam Navy, and

4. From two to three hours are required to raise the steam.

Never surely, was there a more striking instance of success in trying "how not to do it."

There is no difficulty whatever by simple and inexpensive alterations in the gunboat boilers and engines, in getting rid of the steam-blast in the chimney; reducing the consumption of fuel one half, to accomplish the same distance as before, or in other words to propel the boats twice the distance for the same amount of fuel; supplying the boilers with pure water, thus avoiding the heavy repairs rendered necessary by the use of salt water in small boilers, that cannot be cleaned: and lastly, raising the steam in one-fourth the time required at present.

To those entering the field of steam engineering, we would say, despise no man's opinion or experience—hear all you can, but be careful what you retain for use—those engineers who have been noted for their disrespect and contempt for the opinions of others, are always those who have made the greatest blunders in their own practice.

Successful engineering consists greatly in a wise selection from an extensive experience, and not from that alone of one individual, which is necessarily partial and limited.

In the design and construction of steam engines, the manufacturer is seldom in a position to keep pace with the requirements of the users of steam power, and in proposing changes of construction, tending to economize, he has some difficulty in obtaining compensation for additional cost in increasing the duty realized from a given amount of fuel.

If in the construction of railways it was found necessary to introduce a professional man between the proprietor and the contractor, it is still more necessary in the construction of steam machinery, if it is wished to have that machinery designed on the best principles.

At the same time, however, we fear steam engineers of the ability and judgment necessary to take this middle position, are very difficult to be found, and too often the duties are undertaken by incompetent and inexperienced men, who by their blunders create a prejudice against a division of labour, that benefits both the user and the manufacturer of steam machinery.

The wide, and, we may add, the opening field of steam engineering is full of promise, indeed, there is no branch of engineering to be compared with it, as regards a certainty of radical and extensive improvement.

In marine engineering, alone, a lifetime is required to make but limited progress, and the influence of that progress will be felt throughout the whole world.

Finally, we must express the hope that these papers will not be entirely fruitless, but that some of our readers will, by their perusal, be induced to assist in the great and important work of STEAM REFORMATION.

TREDGOLD'S FORMULA FOR THE THICKNESS OF CAST IRON CYLINDERS,

By Mr. F. Gray.

In "Tredgold on the Steam Engine," articles 518 to 520, a formula is given for the thickness of cast iron cylinders and pipes to withstand the strain arising from unequal expansion. There is an algebraic error in the process of determining that formula which renders it erroneous.

The notation used is t = thickness of cylinder a = diameter of cylinder, both in inches, aud p = double the whole force of steam when escaping at the safety valve, in pounds per circular inch.

In the preceding article he has determined $t = \frac{2{\cdot}54\, a\, p}{15{,}000}$ if the cylinder is of uniform temperature.

For the effect of unequal expansion he calculates the loss as follows. He supposes one half of the cylinder to be heated 300° more than the temperature of the opposite half. The heated side will be expanded $300 \times \frac{1}{162000} = \frac{1}{540}$ and the other side straiued by this expansion. This strain will be about a neutral axis situated in the centre of the thickness of the cool side, compressing the metal on the outside of the axis, and extending it on the inside. The greatest extension will be at the internal surface, and its amouut will be to the expansion of the heated side, as half the thickness of the cylinder is to its diameter, nearly, or as $\frac{t}{2a}$. At 300° excess of heat, this extension will be $\frac{1}{540} \times \frac{t}{2a} = \frac{t}{1080a}$. The greatest expansion cast iron will bear without deterioration he assumes as $\frac{1}{1200}$. The extension by the strain of expansion divided by this, will give the proportionate loss of cohesive force, thus $\frac{t}{1080a} \div \frac{1}{1200} = \frac{1{\cdot}1\, t}{a}$. Tredgold adds "generally, or rather in all cases, a considerable portion of surface is directly affected by the heat; in this case a near approximation will be to double the effect of expansion."

This will give $\frac{2{\cdot}2\ t}{a}$ as the loss of cohesive force, and he adds this to the former value of t for for a corrected value for irregular expansion. He adds $\frac{2{\cdot}2\ t}{a}$ as if it were a part of an inch whereas it is an abstract quantity expressing the proportion between the cohesive force lost and the original cohesive force of the material. His final equation is $t = \frac{a p}{6000} \left(\frac{a}{a-2{\cdot}2}\right)$ and he remarks upon this formula that "the effect of irregular expansion is sensible only iu small cylinders," whereas the corrected formula will show that the opposite of this is true, and that $\frac{t}{a}$ is not a function of a as Tredgold has it, but that it is a function of p.

Instead of adding the loss it should be taken from unity, and the former value of t divided by the remainder; thus—

$$t = \frac{2{\cdot}54\, a\, p}{15000} \div \left(1 - \frac{2{\cdot}2\, t}{a}\right) = \frac{a^2\, p}{6000(a - 2{\cdot}2\, t)}$$

$$\text{Then } t^2 - {\cdot}454\, at = -\frac{a^2\, p}{13200}$$

Solving this quadratic we have—

$$t = (.227 - {\cdot}0087 \sqrt{681 - p})\, a$$

This is the corrected formula according to Tredgold's premises, aud to this he proposes to add half an iuch for wear.

If we alter some of the premises I think a more correct formula would be obtained. Tredgold takes the greatest extension cast iron will bear, without injury, as $\frac{1}{1200}$; but if we take the ultimate cohesive force = 16000lbs; and the proof load at $\frac{1}{4}$th of this, = 4000lbs; also the modulus of elasticity at 18,000,000; then the greatest extension must not exceed $\frac{4000}{18{,}000{,}000} = \frac{1}{4500}$. The loss of cohesive force will now be $\frac{t}{1080\, a} \div \frac{1}{4500} = \frac{8{\cdot}34\, t}{a}$.

Let us take the working strain at one half of the proof, or $\frac{1}{8}$th of the ultimate, = 2000lbs; and suppose that the pressure in the cylinder may be $\frac{1}{3}$th more than the load on the safety valve, which it might actually be, either by water in the cylinder or compression at the termination of the stroke.

Also, let p = the load on safety valve in lbs. per *square* inch; t = thickness and a = diameter.

If the cyliuder be of uniform temperature its thickness will be $= \frac{a\ p}{3330}$.

For unequal temperature the thickness will be $t = \frac{a^2\ p}{3330\,(a - 8{\cdot}34\, t)}$

Which becomes

$$t^2 - {\cdot}12\, at = -\frac{a^2\ p}{27{,}800} \qquad (A)$$

And solving this quadratic

$$t = {\cdot}06\, a\, (1 - {\cdot}1 \sqrt{100 - p}) \qquad (B)$$

The solution of the quadratic gives $\pm\, {\cdot}1 \sqrt{100 - p}$, but the negative sign is *always* the correct one, because, if for t in equation (A) we substitute na

$$n^2\ a^2 - {\cdot}12\, n\, a^2 = -\frac{a^2\ p}{27{,}800.}$$

Divide by a^2

$$n^2 - {\cdot}12\, n = \frac{-p}{27{,}800.}$$

p is a maximum when its differential coefficient is $= o$, or when

$$d\,({\cdot}12\, n - n^2) = o.$$

Differentiatiug,

$${\cdot}12\, d\, n - 2\, n\, dn = o$$

$n = {\cdot}06$ is the minimum value of n

and $p = 100$ is the maximum value of p.

Referring to formula (B) we will find the same to be the case.

The formula B gives thickness absolutely required for strain according to the premises assumed, any allowance for wear or other strains must be added. The following shows it applied for various pressures without allowance:—

p =	t =	
15	·0042 diameter.	
20	·0063	
30	·0028	If p, the load on safety valve be less than 15lbs. p must be taken = 15.
40	·0135	
60	·022	
80	·033	
100	·06	

TRIAL TRIP OF THE SCREW STEAMER "THUNDER."

This beautiful vessel (which is now taken up as a transport by government for China) made a trial of her speed, November 3rd, and created a great deal of interest on account of her speed and wonderful economy, the result as to speed being over 14 knots, with a consumption of 1lb. of coal per indicated horse power per hour, the usual quantity being from 3 to 4lbs. The following are the principal dimensions of the vessel and engines:—

	Ft.	in.
Length	240	0
Beam	30	0
Depth	22	6
Diameter of cylinders		55
Stroke	3	0
Draught forward	10	8
do. aft.	13	8
Revolutions	58 to 60	
	Tons.	
Builders' tonnage	$1062\frac{7}{9}\frac{2}{4}$	
Nomiual horse power of eugines	210	

The cylinders are belted, engines are fitted with expansion gear, thrust and friction coupling to euable the engines to be disconnected speedily. The boilers are tubular, and are fitted with Beardmore's superheating apparatus, which worked at a temperature of 300°. Pressure guage at 19lbs. vacuum, 25½ to 26in. The indicated horse power by the diagrams was from 950 to 1000, the consumption of coal was 820lb. per hour, or about 1lb. per indicated horse power per hour. At the time of trial, the immersed midship section was 342ft. The vessel was designed by Mr. J. Dudgeon of Fenchurch St., a most successful designer of quick sailing vessels. The engines were made by Messrs. J. & W. Dudgeon, of Sun Iron Works, Millwall, and are most excellent specimens of machinery. The admirable manner in which they worked was the subject of special remark. The vessel was built by Mr. C. Langly, of Deptford Green Dock Yard, under the superintendence of Mr. J. Dudgeou.

A more exteuded trial took place, when the results were as follows:—

With superheaters and full expausion, at 54 revolutions per minute, with 19lbs pressure consumption of Dufferin coal, was about the same within a trfle of that consumed during the trial on the 3rd November, the coal being accurately weighed.

The boilers are tubular, two in number, each has 4 furnaces (fired fore and aft.) 360 tubes to each, varying in diameter, the rows nearest to the furnaces being larger than the upper. The superheaters are on Mr. Beardmore's plan, and consist of boxes, with tubes passing through the funnel from one to another, A superheater is fixed to each boiler, being placed on top of same, the boxes being outside the funnels, and the tubes passing through. These tubes are 2in. in diameter, each superheater has 172, the area of the stop valves, of which there are two, is 190, 12 square inches. The funnels are 4ft. 6in. in diameter, and at the lower portion, or that part which rests on the boilers are made of a rectangular form. 6ft. 6in. × 4ft. 6in. × 3ft. 3in. high, it is iu this portion the superheating is effected.

THE GREAT DREDGING SCHEME FOR THE RIVER TYNE.

DESCRIPTION OF THE PROPOSED DREDGER, &c.

WE are enabled to lay before our readers the following interesting account of the large dredging machine and hopper barges to be built by the Tyne Commission.

The hull of the dredger is to be of iron, of the following dimensions:—

Extreme length	250 feet.
Extreme breadth	37 „
Depth of hold	12 „

These dimensions give a capacity of about 2,200 tons. This immense vessel is to be of the same general scautling as a first-class vessel of the same tonnage. She is divided into nine water-tight compartments; is flat-bottomed; and will, with all her machinery on board, draw about five feet of water. The feature of this machine, that stamps her at once original, is the fact of her having four internal wells, and four ladders or bucket frames, a peculiarity of construction never before attempted, if conceived.

The centre part of the vessel's hull above deck will be occupied by the main framing, composed of hollow box beams of malleable plate iron 12 inches square, spread in a triangular form, the base being 36 feet, and the apex 13 feet in the fore and aft directions. This framing is formed of four distinct vertical frames, bound together transversely by box beams of the same scantling, the whole being a rigid support for the upper tumblers, four in number, and the heavy gearing and shafts required to work them.

The bucket frames are to be 86 feet long between the centres of the upper and lower tumblers, and formed of two flat iron beams, 57 inches deep at the centres and 18 inches at the ends, composed of a vertical plate $\frac{5}{8}$ of an inch thick, and flanked on both edges by angle iron $4 \times 4 \times \frac{5}{8}$, having rivets every four inches; the upper and lower edges of this beam are to be covered by plates of malleable iron, $\frac{1}{2}$ inch and $\frac{5}{8}$ inch thick respectively; hollow box beams 15 inches broad, and the whole depth of the beam when they occur to be placed at intervals forming a transverse tie between the sides. Malleable irou straps, having bushes, keys, &c., for securing the ladders and tumblers at either end will be attached in a strong and substantial manner. Each ladder will have a continuous pitch chain, composed of malleable iron links, carrying 39 buckets of wrought iron, each bucket having capacity for lifting one-third of a ton of sand, so that allowing the whole four ladders to be working, and half the buckets full, which will be the case, we have a continual stream weighing about 26 tons going over the ladders to the shoots. The motive power is a side lever condensing marine engine of the nominal power of 80 horses, capable of exciting an indicated actual power of 200 horses. By meaus of gearing the power is transmitted to two main lying shafts, one running forward and the other running aft. These, by means of conical drums and belts, give motion to the smaller shaftiug, driving the crabs, surging heads, &c. The hoisting barrels of the bucket frames are driven by gearing from the main lying shafts. The spur gearings of the four ladders is so arranged that any of them can be stopped and started at pleasure, without stopping the main engine, or in any way interfering with the working of the rest of the machinery of the dredger. Two large force pumps are provided for throwing water into the shoots, should the nature of the dredgings require it. Feed and bilge pumps are driven from the main engine, and a supplementary engine for driving a pump, and a hand force pump are also provided, for pumping into or out of the main boilers, out of the bilges, or on to deck, as may be required.

The steam is to be generated in four cylindrical flue boilers—two forward and two aft of the engines—each 16ft. long and 6ft. 3in. diameter, having steam chests rising 3ft. above the deck, from which brauch the steam pipes, which, with all the pipe connections in the engine room, are to be of the best hammered copper. The boilers to be capable of maintaining and working at a pressure of 20lbs. per square inch.

The overhanging shoots by which the dredgings are conveyed to the hopper barges are hinged—one on each side to the main framing, and are 23ft. in length, —they are constructed of wrought-iron plates and angle iron, and are eight feet wide at their inner ends, and four feet at their outer ends. Each shoot is provided with three openings in the bottom provided with hinged doors. Thus, including the mouth, giving four distinct points of delivery for dredgings, this being required to fill the entire breadth of the carrying spans of the hoppers, and to avoid the troublesome necessity of spreading the dredged stuff, which, in the ordinary machines, has to be performed by hand.

The shoots themselves are raised and lowered to any required position by machinery, and an apparatus is supplied to each door of the openings in the bottoms, by which they can be opened and shut at pleasure, by means of small drums, brakes, and clutches worked from the main engine. Thus, each shoot, with its doors is perfectly manageable and under control, one man only being required to work it. The vessel will have cabins built and fitted with all the requirements for officers and crew, and large store rooms for engineers and boatswain's stores. A large and convenient engine-house is to be formed on deck, between the main framing aud the whole of the gear wheels and shafts, covered in, to effectually guard from weather and accident.

We now come to a description of the hopper barges, required to co-operate with this monster dredger. These are to be three in number, on the side-door principle, and each is an independent screw steamer capable of carrying out to sea in fine weather 800 tons of dredged stuff. Their dimensions are as follows.

Extreme length	155 feet.
Extreme breadth	30 „
Depth amidships	13 „
Depth at ends	20 „

The after end of the vessel, 45 feet in length, will contain the engines, coal bunkers, supplementary engines, large bilge and hand pumps, &c.

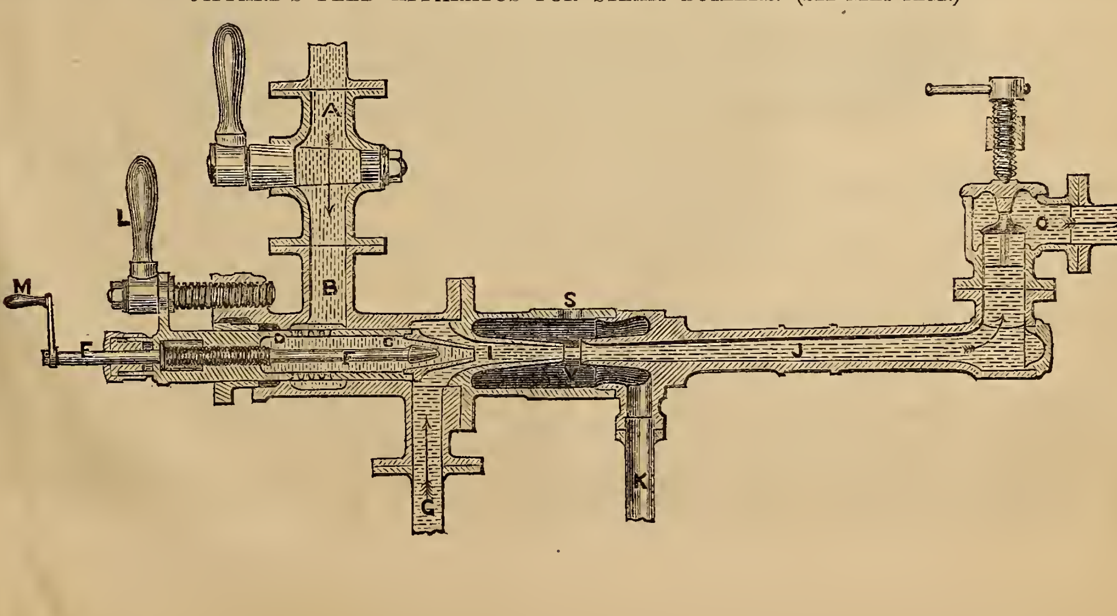
The motive power is derived from a pair of condensing marine screw engines, having inverted cylinders of 30 inches diameter, and adapted for a stroke of 30 inches, placed upon strong cast metal framing. These engines are directly connected to the screw shaft, and will work from 65 to 70 revolutions a minute. The air pumps are to be of brass, having india rubber valves, and will work by means of malleable iron from the crossheads of main engines. Feed and bilge pumps will also be wrought from these beams.

The supplementary engines to consist of two cylinders—non-condensing—each 10 inches in diameter, and 9 inches length of stroke, connected to a malleable iron cranked shaft, upon which is keyed a fly wheel and a bevel gear wheel, from which the motion is taken to drive the surging heads, crab, &c., in fore and aft divisions of the vessel. A pump is also driven by this engine for pumping into the boilers out of the bilges or on deck, as may be required. A double-action hand force pump is also placed in the engine room, for pumping into the boilers, or pumping out of them, and on deck, as may be required.

The steam for driving these engines is to be generated in six cylindrical boilers, each 8 feet long and 4 feet 6 inches in diameter, having cylindrical flues passing through steam chests which rise to deck level; the six flues discharge into common smoke box rising three feet above the deck, and surmounted by a funnel 20 feet in height, and 45 in diameter. Each boiler is to have one furnace 2 feet 6 inches wide, and 4 feet 6 inches long, to be fitted with an apparatus for preventing smoke. These boilers to work at a common pressure of 25lbs. per square inch.

The deck of the after part of the vessel is the same thickness as the forward deck, viz., 3 inches. Two surging heads driven by power are to be placed well aft. A powerful and improved steering gear, with binnacle and everythiug requisite for the proper navigation of the vessel, will be provided and fitted.

GIFFARD'S FEED APPARATUS FOR STEAM BOILERS. (SEE NEXT PAGE.)



GIFFARD'S FEED APPARATUS FOR STEAM BOILERS.

We present our readers with the following description (with illustration) of M. Giffard's Feed Water Apparatus, the English patent for which dates 23rd July, 1858. It relates to a peculiar construction and arrangement of apparatus for supplying the feed water or other liquid to steam or other boilers, and for raising and forcing fluids generally. According to this invention, the impulse force of a steam jet or blast is made to raise and force the fluid required. For this purpose an apparatus of a peculiar construction, but having no working or moving parts, is employed. This apparatus, which may be considerably modified without changing the principle of its action, consists, according to one arrangement, as applied to a steam boiler, of a steam jet or injection pipe, which receives the steam from the boiler, and directs it in a continuous jet into a small passage, the lower end or mouth of which is expanded sufficiently to admit of the entrance of a stream of water, which, by surrounding the steam jet pipe, forms an annular jet of water with the steam jet in the centre. The water is drawn from a well or tank in any convenient situation. This arrangement of jets may, however, be reversed, that is, the steam jet may be annular, and the water jet in the centre of it; or two steam and water jets may be used in certain cases, such as where the condensation of the steam is not sufficiently rapid, owing to the heated state of the water in the hot well or tank of the engine. The water has an impulsive force imparted to it by the steam jet, and simultaneously receives a considerable amount of heat therefrom, before it enters the boiler. On issuing from the narrow passage above referred to, the jet of water enters a second passage which is expanded slightly at its lower end for a short distance, and also at its upper end, such expansion of the upper portion being gradual from the commencement of the lower expansion. This boiler expansion or conveyance serves to maintain the entering jet compact, whilst the upper diverging portion serves to diminish gradually, and without shock, the impetus which has been imparted to the fluid. A small valve is interposed between the boiler and jet pipes so as to prevent the escape of water from the boiler when the feed apparatus is out of action. By making the steam or water jet pipe moveable or adjustable in regard to each other by means of screws or other suitable regulating apparatus, the quantity of water elevated and forced may be controlled to a great nicety. By a slight modification of this apparatus it may be made to serve as a cock.

The illustration represents a vertical section of an arrangement of the apparatus, which may be modified and varied in many ways. C D is the steam jet pipe, which is fitted with a contracted nozzle, and receives the steam through the pipe A B direct from the boiler, and discharges it in the form of a constant or continuous jet into a species of small chamber, I. This chamber is expanded at the bottom, so as to admit of the free passage of an annular jet of water, which is drawn up through the pipe G, by the action of the steam jet, from the hot well, or other supply reservoir, and is thus brought into immediate contact with the steam, which transmits an impulse to it, and simultaneously raises the temperature; thus, there will issue from the chamber through I, a jet of water only more or less heated. A short distance from the jet I, is a mouthpiece J, the extremity of which is gradually contracted inwards, so as to unite or collect in one compact vein the liquid jet which issues from the nozzle in the chamber I, in a more or less broken or scattered state, whilst the remote portion of the mouthpiece is expanded gradually, so as to cause the jet to lose successively, and without shock to the liquid, the speed which it has attained, so that it may arrive at the upper portion of the apparatus at a pressure at least equal to that of the boiler, without possessing any notable speed, and consequently without loss of *vis viva*. Above the expanded mouthpiece J, or at any other convenient part of the apparatus, is fitted a small valve O, the object of which is to prevent the escape of water from the boiler when the apparatus is not at work. Beyond this valve is the pipe P, which conducts the feed water to the boiler. Below the valve O is a branch pipe furnished with a stop-cock, upon which pipe a manometer or pressure guage may be fitted when required for experiment. The delivery, and the suitable proportion of water to be injected in relation to the power of the steam jet, and to the smallest diameter of the mouthpiece J, is adjusted or regulated by means of the regulating screw L, the effect of which is to increase or diminish the distance between the two nozzles C F, and thereby enlarging or contracting the annular jet of water.

AMERICAN NOTES FOR 1859, No. 6.

DIMENSIONS OF STEAMERS.

Steam Ferry-boats "Marion" and "General Warren."

Built by Rosevelt and Joyce; engines by The Novelty Iron Works.

DIMENSIONS.

	Ft.	10ths.
Length on deck	142	6
Breadth of beam	33	0
Depth of hold to spar deck	12	4
Length of engine space	59	0
	Tons.	
Tonnage	521	

Fitted with a vertical beam engine; drop-flued boiler; diameter of cylinder, 38in.; length of stroke, 9ft.; diameter of paddle-wheels over boards, 18ft. 6in.; length of boards, 8ft., depth, 2ft., No., 18; No. of boilers, 1, length, 25ft., breadth, 9ft., height, exclusive of steam chests, 9ft.; No. of furnaces, 2, breadth, 3ft. 10in.; length of fire bars, 6ft. 10in.; No. of flues, 16, internal diameter, 2 of 24in. and 2 of 14in.; length 13ft. 6in. and 11ft. 3½in.; diameter of chimney, 3ft.4in., height, 40ft.; area of immersed section at load draft, 170ft.; heating surface, 1198ft.; date of trial, August, 1859; draft forward, 6ft., aft, 6ft.; average revolutions, 23; weight of engine and wheels, 63,700 lbs., boiler, without water, 31,159 lbs.; frames, 13in. × 5½in., and 24in. apart; independent steam, fire, and bilge pumps, 1. Intended service, New York to Brooklyn.

Steamer "York-town."

Built by William H. Webb; engines by The Morgan Iron Works.

DIMENSIONS.

	Ft.	Ins.
Length on deck	250	0
Breadth of beam	34	0
Depth of hold at beam	9	6
Depth of hold to spar deck	17	0
Length of engine and boiler space	78	0
	Tons.	
Tonnage	1400	

Fitted with a vertical beam engine; return-flued boilers; diameter of cylinders, 2 of 50in.; length of stroke, 10ft.; diameter of paddle-wheels over boards; 30ft., length of boards, 9ft., depth, 1ft. 6in., No. 26, No. of boilers, 2, length, 34ft., breadth, 14ft., height, exclusive of steam chests, 12ft. 6in.; No. of furnaces, 6, length, 4ft. 2in., length of fire bars, 7ft.; No. of flues, 28, internal diameter, 11, 16, and 19in., length, 21 and 27ft.; diameter of chimney, 6ft. 8in., height, 39ft.; area of immersed section, 330ft.; load on safety valve in lbs. per square inch, 25; cut off, half stroke; heating surface, 6000ft.; contents of bunkers in tons, 150; consumption of coals per hour, 1 ton; date of trial, July, 1859; draft forward, 11ft. 6in., aft, 11ft. 6in.; average revolutions, 20; frames, 15in. × by 15in., and 30in. apart; number of bulkheads, 2; independent steam, fire, and bilge pumps, 1.

DESCRIPTION.

Masts, two; rig, foretopsail schooner. Intended service New York to Richmond.

Steam Ferry-boats "Etham Allen" and "Commodore Perry."

Built by Thomas Stack; engines by The Novelty Iron Works.

DIMENSIONS.

	Ft.	10ths.
Length on deck	144	6
Breadth of beam	33	0
Depth of hold to spar deck	12	6
Length of engine space	59	0
	Tons.	
Tonnage	527	

Fitted with a vertical beam engine; drop-flued boiler; diameter of cylinder, 38in.; length of stroke, 9ft.; diameter of paddle-wheel over boards, 18ft. 6in.; length of boards, 8ft., depth, 2ft., No., 18; No. of boilers, 1, length, 25ft., breadth, 9ft., height, 9ft.; No. of furnaces, 2; breadth, 3ft. 10ft.; length of fire bars, 6ft. 10in.; No. of flues, 16, internal diameter, 2 of 24in. and 14 of 14in., length, 13ft. 6in. and 11ft. 3½in.; diameter of chimney 3ft. 4in., height, 40ft.; area of immersed section at load draft, 170ft.; heating surface 1198ft.; date of trial, September, 1859; draft forward, 6ft., aft, 6ft.; average revolutions, 23; weight of engines and wheels, 63,700 lbs.; weight of boilers, without water, 71,159 lbs.; frames, 13in. × 5½in. and 24in. apart; 1 independent steam, fire, and bilge pump. Intended service, New York to Brooklyn.

Steamer "Florida."

Built by S. Whitlock; engines by E. H. Delamater, New York.

	Ft.	10ths.
Length on deck	180	0
Breadth of beam (moulded)	31	0
Depth of hold	9	0
Depth of hold to spar deck	16	0
	Tons.	
Tonnage	700	

Fitted with a vertical direct engine; return flue boiler; diameter of cylinder, 36in.; length of stroke, 3ft. 6in.; diameter of screw, 10ft., length, 3ft. 6in., pitch, 18ft. 4 blades; 1 boiler, length, 24ft., breadth, 10ft. 6in., height, exclusive of steam chimney, 11ft. 10in.; 2 furnaces, breadth, 4ft. 6in.; length of grate bars, 7ft. 6in.; 20 flues above, 10 below, internal diameter, 8 of 13½in., 2 of 20in., length above, 16ft. 2in., below, 10ft. 8in.; diameter of smoke pipe, 3ft. 11in.; date of trial, October, 1859; point of cutting off, one third; frames, moulded, 12in., sided, 14in., 26in. apart from centres; 1 independent steam, fire, and bilge pump.

DESCRIPTION.

2 masts, schooner rig; intended service, New Orleans to Apalachicola.

Steamer "Seth Grosvenor."

Built by Henry Steers, New York; engines by the Allaire Works, New York; Charles H. Haswell, Superintending engineer.

Built for the New York State Colonization Society.

DIMENSIONS.

	Ft.	Ins.
Length on deck	95	0
Breadth of beam (moulded)	16	10
Depth of hold to spar deck	5	0
Length of engine room, 27ft. × 6ft.		
Area of immersed section at load draft of 3ft	39	0
	Tons.	
Tonnage	68	

Fitted with a steeple engine; return tubular boiler; diameter of cylinder, 28in.; length of stroke, 3ft.; diameter of water wheel over boards, 13ft. 6in. length of wheel blades, 3ft., depth, 1ft. 3in.; 14 blades; 1 boiler, length, 12ft. 6in., breadth, 5ft. 9in., height, exclusive of steam chimney, 6ft. 10in.; 1 furnace, breadth, 5ft.; length of grate bars, 4ft. 6in.; 36 tubes, internal diameter, 30 of 4in., 6 of 3in.; internal daimeter of flues, 2 of 8in., 2 of 15in.; length of tubes above, 9ft.; length of flues below, 6ft.; diameter of smoke pipe, 2ft. 4in., height, 24ft.; draft forward, 3ft., draft aft, 3ft.; date of trial, December, 1859; cube of grate surface, 22ft. 5in.; heating surface, 540 square feet; consumption of fuel per day, 2 tons; maximum pressure of steam, 25lbs.; point of cutting off, one third; frames, moulded, 7in., sided, 3in., 16in. apart from centres; depth of keel, 4in.; 1 independent steam, fire, and bilge pump.

DESCRIPTION.

2 masts; schooner rig; intended service, from Cap Palmas to Montsona, Coast of Africa.

STEAMER "NEW LONDON."

Built by George Greenman & Co., Mysbic, Connecticut; engiues by C. H. Delamates, New York.

	Ft.	Ins.
Length on deck	135	0
Breadth of beam (moulded)	26	0
Depth of hold	8	6
	Tons.	
Tonnage	260	

Fitted with a vertical direct engine; return tubular boiler; diameter of cylinders, 34ins.; length of stroke, 2ft. 6in.; diameter of screw, 9ft., length, 1ft. 6in., pitch, 17ft, 4 blades; 1 boiler, length, 18ft., breadth, 8ft. 8in., height, 8ft. 8in.; 2 furnaces, breadth, 3ft. 3in.; length of fire bars, 7ft.; 26 flues, diameter of flues above, 16 of 8in., below, 8 of 9½in. and 2 of 16in., length above, 16ft. 10in., below, 9ft. 8in.; diameter of chimney, 3ft.; date of trial, November, 1859; draft forward, 8ft., aft, 10ft.; frames, 12in. × 8in., and 9in., 24in. apart at centres; 1 independent steam, fire, and bilge pump.

DESCRIPTION.

3 masts; schooner rig; iutended service, New York to New London.

STEAM-TUG "INDIA."

Built by Harlan, Hollingsworth & Co., Wilmington, Delaware.

DIMENSIONS.

	Ft.	Ins.
Length on deck	86	0
Breadth of beam (moulded)	18	0
Depth of hold to spar deck	8	0
Length of engine space	30	0
	Tons.	
Tonnage	$113\frac{23}{95}$	

Fitted with a vertical direct engine; return flue boiler; diameter of cyliuder, 26in.; length of stroke, 2ft.; diameter of screw, 7ft., length, 2ft. 10ins., pitch, 12ft.; number of blades, 4; 1 boiler, length, 13ft. 6in., breadth, 7ft., height, exclusive of steam chests, 7ft.; number of furnaces, 2, breadth, 3ft.; leugth of fire bars, 6ft. 6iu.; number of flues, 14, internal diameter, 6in., length, 9ft. 6in.; diameter of chimney, 3ft. 2in., height, above grates, 30ft. 6in.; area of immersed section at load draft of 6ft. 9in., 78 sq. feet; load on safety valve in lbs. per sq. inch, 40; heatiug surface, 552ft.; consumption of coals per hour, ⅛ ton; draft forward, 6ft. 9in., aft, 6ft. 9in.; revolntions at above pressure, 100; weight of engines, 28,000 lbs., boilers, with water, 34,000 lbs.; shape of frames, |, 3in. × ⅝in. and 18iu. apart; number of strake of platesfrom keel to gunwale, 7; thickness of plates, $\frac{5}{10}$in.; 1 bulkhead; diameter of rivets ⅝in., distances apart, 2in.; single rivetted; depth of keel, 12iu., dimcnsions, ⅜in. × 6in.; intendcd service, Harbour of Havana.

STEAMER "PENGUIN."

Built by C. H. Mallory, Connecticut; engines by C. H. Delamates, New York; owners, The Commercial Steam Boat Company.

DIMENSIONS.

	Ft.	Ins.
Length on deck	165	0
Breadth of beam	30	0
Depth of hold to spar deck	10	0
Length of engine space	10	0
	Tons.	
Tonnage	460	

Fitted with a vertical direct (Ericsson's) engine; return tubular boiler; diameter of cylinder, 48in.; length of stroke, 2ft.; diameter of screw, 11ft. 6in., length, 4ft. 6in., pitch, 20ft., 4 blades; 1 boiler, length, 20ft., breadth, 14ft., height, exclusive of steam chests, 13ft. 6in.; 3 furnaces, breadth, 4ft.; length of fire bars, 7ft. 6in.; 93 tubes, internal diameter, 3½in., length, 15ft.; diameter of chimney, 4ft. 4in., height, 20ft.; area of immersed section at load draft of 12ft., 323 sq. feet; load on safety valve in lbs. per sq. inch, 30; heating surface, 2000ft.; date of trial, November, 1859; draft forward, 10ft. 6in., aft, 12ft.; maximum revolutions, 70; frames, 14in. × 9in., and 11in. and 26in. apart; depth of keel, 14in.; 1 independent steam, fire, and bilge pump.

DESCRIPTION.

Three masts; schooner rig. Intended service, New York to Providence.

STEAMER "GEORGE ANNA."

Built by Harlan, Hollingsworth & Co., Wilmington, Delaware.

DIMENSIONS.

	Feet.
Length on deck	208
Breadth of beam (moulded)	30
Depth of hold	10
Depth of hold to spar deck	18
Length of engine space	60
	Tons.
Tonnage	$574\frac{65}{95}$

Fitted with a vertical beam engine; tubular boilers; diameter of cylinders, 44in.; length of stroke, 11ft.; diameter of paddle wheels over boards, 28ft., length of boards, 8ft., depth, 1ft. 10in., uumber, 20; 1 boiler, length, 14ft., breadth, 14ft., height, exclusive of steam chests, 11ft. 6in.; 5 furnaces, breadth, 3ft. 6iu. and 2ft. 6in.; length of fire bars, 6ft.; 154 tubes, internal diameter, 3¾in.; diameter of chimney, 4ft. 6in., height above grates, 46ft.; area of immersed section at load draft of 6ft., 168 sq. feet; load on safety valve in lbs. per sq. inch, 30; heating surface 2114ft.; consumption of coals per hour, ¾ ton; date of trial, September, 1859; draft forward, 6ft., aft, 6ft.; maximum revolutions at light draft, 22; weight of engines, 210,000 lbs., boilers, with water, 90,000 lbs.; shape of frames, |, 3in. × ¾in. aud 18in. apart; number of strake of plates from keel to gunwale, 11; thickness of plates, ½in. to ⅜in.; 3 bulkheads; diameter of rivets, ⅝in., distances apart, 2in.; single rivetted; depth of keel, 6in., dimensions, ½in. × 6in.; 1 independent steam, fire, and bilge pump. Intended service, Richmond to Baltimore.

STEAMER "CHAMPION."

Built by Harlan, Hollingsworth, & Co., Wilmington, Delaware; engines by The Allaire Works, New York.

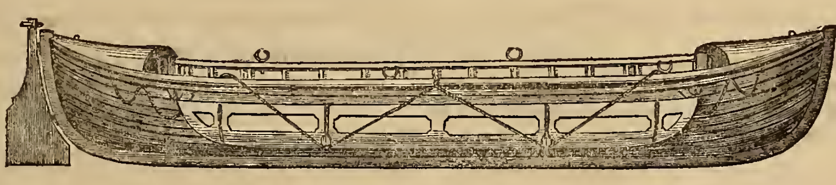
DIMENSIONS.

	Ft.	10ths.
Length on deck	242	0
Length at load line	235	0
Breadth of beam (moulded)	35	0
Depth of hold	18	2
Depth of hold to spar deck	25	10
Length of engine-room	66	0
Area of immersed section at load draft of 10ft	346	0
	Tons.	
Tonnage	1490	

Fitted with a pair of vertical beam engines; return flue boilers; diameter of cylinder, 42ins.; length of stroke, 10ft.; diameter of water wheel over boards, 30ft.; length of wheel blades, 6ft. 6in., depth, 1ft. 6in., number, 26; number of boilers, 2, length, 24ft., breadth, 10ft. 6in., height, exclusive of steam chimney, 9ft. 6in.; number of furnaces, 2 in each, breadth, 4ft. 8in.; length of grate bars, 7ft. 1in.; number of flues above, 5, below, 10, internal diameter above 1ft. 5½in., below, 2 of 21in., and 8 of 13in., length, above, 17ft. 4¼in., below, 11ft. 10in.; diameter of smoke pipe, 5ft 7in., height above grates, 56ft.; draft forward, 10ft., aft, 10ft.; date of trial, September, 1859; heating surface, 2491 sq. feet; consumption of fuel per hour, 1 ton; maximum pressure of steam, 30 lbs.; point of cutting off, half stroke; maximum revolutions at above pressure, 20; coutents of coal bunkers, 500 tons; weight of engines, 340,000 lbs., boilers, with water, 190,000 lbs.; shape of frames, |, depth, 4in., width, 1⅛in., floors, 18 and 20 ins. apart at centres; number of strakes of plates from keel to guuwale, 15; thickness of plates, ¾, ⅝, ½, $\frac{7}{16}$in.; cross floors 22in. high, 8ft. apart, $\frac{9}{16}$ and ½in. thick, capped with angle iron stringers on main deck, 24 × ½in.; deck clamps, L 26 × ⅝in.; depth of keel, 7in., dimensions, $\frac{3}{16}$in; diameter of rivets, ¾in., distance apart, 2¼in.; single and double riveted; 1 independent steam, fire, and bilge pump; boilers, chimney, and smoke pipe, protected from communicating fire by felt and iron.

DESCRIPTION.

Two masts; foretopsail schooner rig; 3 bulkheads; 39 state rooms and 315 steerage berths; 12 fore and aft keelsons, 2 of 42 inches high × $\frac{9}{16}$in. thick, 10 of 20iu. high × ½ aud $\frac{9}{16}$iu. thick. Intended service, Pacific Oceau.



The following inventions are attracting attention in America.

LUDLUM'S PATENT LIFE BOAT.

The inventor seut a boat 20ft. long to Europe, and it is now, we believe, on exhibition at the yard of Mr. Forrest, the celebrated builder of life-boats, in Limehouse, London.

The following is a brief description of the boat. It provides life and other boats with hollow adjustable floats along their outer sides, and water tight compartments within.

The floats are made of a conical or egg form, in their tranverse section; and so fitted to the boat as to secure their greater buoyancy when first touching the water. They are constructed of teu (more or less) canisters, of copper, India-rubber, (in case of gun boats) galvanized irou, or other material arranged in a series, and terminating in elevated prows. Between the canisters are placed braces of wood or other material, of any desirable thickness, thus securing the floats from injury. The canisters are covered with wood, and are of such shape as to be well protected by the gunwales.

The floats are made adjustable, by their hinging or looping, from their upper edge, to the sides of the boat. They are fastened close under the boat's sides, or are turned outward and upward, by chains or ropes from their iuner aud outer sides, to hooks above in the boat. And should the boat be placed bottom upwards, she will, by a safe and simple contrivance, fold her "fins" or floats, from their extended position, close under her sides, right herself, and immediately extend them as before. A boat thus "winged," or "finned," will never swamp or capsize; and is so much like nature as not to be improved upon.

The floats may be varied to suit the different styles of boats to which they are attached.

The boat, in case of a self-righting and relieving one, is constructed after the general principles of such boats; with a sufficiency of sheer from stem to stern, with high bulk heads, and with a deck over the bottom of the boat, so high that water within, pressing upon valves, will run through tubes, passing through the boat's bottom. These valves are balanced into place by a lever turning upon a pivot, aud are opened downwards by pressure of water from above.

The deck, from the buoyancy of the floats, may be placed much lower than ordinarily, thus avoiding a "top heavy boat," when loaded.

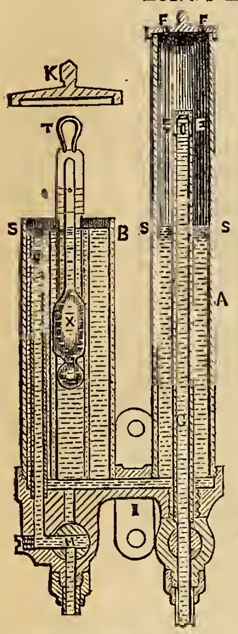
The high bulk heads may be of special service, by placing in their bottoms water tanks, opening through faucets, into the boat, and filling through tubes, from above.

Into the bulk heads, above the tanks, are inserted valvular water-tight doors, thus creating lockers, for the stowage of provisions, instruments, &c. These doors are not liable to be out of place, or injured. They consist of an outer lid, hung, and acting by a spring, upon an inner lid, covered on its inner side with India-rubber, which is pressed against a rim around the edge of the door. The doors may also open to lockers along the sides of the boat.

A boat, thus rigged, and provided with its many "hollow bones filled with marrow," would long sail a shipwrecked crew upon the open seas. These lockers and tanks, when empty, are perfect buoys, and may be omitted, if desired.

[We fear that whilst the floats might assist in maintaining a boat in weathering a rough sea, they would in case of the boat being upset,(and every boat, whatever its form or construction may be, is liable to be upset,) they would present in our opinion, very serious obstacles to her righting, and certainly this should be properly tested, and the question set at rest before the lives of those engaged in so perilous a calling as that of life saving at sea, or along our coasts are sacrificed. —Ed. Artizan.]

LONG'S MARINE SALINOMETER CASE.



This Improvement consists in attaching the cylinder A to the cylinder B of Sewell's Salinometer (or as known in England, How's) having a communication C, as a means of safety to the Hydrometer, perfect accuracy in testing the density of water, and insuring the operator against danger from scalding, &c.

The cylinder or other shaped vessel A is connected with the boiler by the pipe and stop-cock G, the pipe G being closed at the top and having openings at the side, near the top, E E.

The water coming from the boiler and passing the stop-cock G, makes its exit through the openings E E; at this point the steam is liberated from the water and escapes through the openings F F. The water falls into the cylinder A, passes through the opening C, and rises to the water S S S S in both cylinders; D is an overflow pipe to carry off the surplus water and to keep up a sufficient current to maintain the water to be tested, at the required temperature. By turning the stop-cock H, both cylinders can be discharged. T is a thermometer fitting in a slide. X is the hydrometer. K is the cover for closing the case when not in use. I is a bracket for securing the instrument to the boiler, bulkhead, or other suitable place.

This Instrument affords a ready means of drawing water from a steam boiler under any pressure and temperature, without ebullition in the cylinder B or oscillation to the hydrometer.

NOTES OF EVENTS OCCURING IN THE UNITED STATES.

The *Philadelphia Ledger*, of September 1st, says:—Joseph Harrison, Esq., of Philadelphia, has received instructions from parties in Russia, to have constructed a steam fire-engine for use in that country, and has made arrangements with Mr. Alex. McCansland, of this city, to build it.

The same paper, of September 6th, says:—A boiler explosion occurred at an iron foundry, No. 106, Goerck-street, New York, on the 2nd inst. One man was killed, and five others injured. The building was completely demolished.

The *Philadelphia Evening Journal*, September 9th, says:—The boiler at the Spike-factory of Messrs. Dilworth and Bidwell, at South Pittsburg, exploded on the 7th instant, causing considerable damage. Two men were severely scalded, and one, it is feared, fatally; two boys were also badly injured. On the evening of the 26th, says the *Philadelphia Press*, September 28th, the boiler of a freight-engine on the Baltimore and Ohio Railway, exploded at Cameron Station, near Wheeling. The engineer, fireman, and conductor were killed, and several of the men employed at the station were injured—some of them, it is feared, fatally.

The *Philadelphia Press*, October 1st, reports that a boiler exploded on the 30th September, at the Girard Hotel, New York. Two men were killed.

The improvements upon the *Winan's Cigar Steamer* says the *Baltimore Sun*, October 4, have been completed; the original length of the vessel was 185 feet it has been increased to 235 feet. She is now coaling, preparatory to a trial trip at sea.

The boiler of the locomotive engine *Virginia* exploded at Scranton, on the Delaware Lackawanna and Western Railroad, on the 24th instant; five persons were killed.—*Philadelphia Press*, October 25.

The *Philadelphia Ledger*, October 28th, says:—The boiler of the steam saw-mill of Watson and Paine, near Sparta, Edgecombe county, North Carolina, exploded on the 24th inst., instantly killing five persons.

A fearful explosion of a locomotive occurred recently, says the *Philadelphia Press*, October 28th, on the Bellepontaine Railroad. The railroad track was torn up, the tender smashed, and the underworks of the engine broken into a mass of indistinguishable pieces. The engineer and fireman were killed.

The *Philadelphia Press*, October 28th, reports that a terrible accident occurred to the celebrated steamer *New World*, running from New York to Albany, on the evening of the 26th. The walking-beam of the engine and the piston-rod broke, which appears to have occasioned a general smash of the machinery, which is said to have fallen, passing completely through the bottom of the boat. She immediately commenced sinking. Three hundred passengers were on board, of whom four or five were drowned. The remainder were rescued (with the loss of baggage) by a sloop and two tow-boats, which went to the assistance of the sinking steamer.

ASSOCIATION OF FOREMEN ENGINEERS.

On Saturday, the 6th. inst., the members of the London Association of Foremen Engineers, met at 3 o'clock, at St. Swithin's Lane, City. There was a fair attendance on the occasion, and after certain routine duties had been performed, and several new members had been elected, Mr. Hayes, at the instance of the President, continued his interesting series of papers on the "Enfield Rifle." The reader dwelt more particularly on what is named the furniture of the weapon, taking each portion *verbatim*, described its use and mode of manufacture. The entire paper would fill a larger amount of space than can be spared in our columns at present, and an abstract would scarcely do it justice, we therefore content ourselves by stating that the carefulness displayed in its preparation was an evidence at once of the mechanical knowledge of his subject possessed by Mr. Hayes, and of his faculty for imparting that knowledge to others. Several gentlemen connected with the Small Arms Factory at Enfield, including J. Burton, Esq., chief engineer, and Messrs. Williams, Hague, and Hepburn, foremen, were complimented on the amount of important improvements suggested or made by them in the working details of that great establishment and in the manufacture therein carried on.

Colonel Simon with his wonted liberality, had forwarded finished and unfinished specimens of rifle furniture, and those added to the interest and instruction afforded on the occasion.

Mr. Hayes was eulogized by the President, and a vote of thanks also followed the conclusion of his paper. Some interesting matters in connection with the magnetic phenomena of nature, and the Photographic art, illustrated by diagrams, &c., &c., from the Royal Observatory at Kew, following, and Mr. G. Newton's announcement that "the *Stock* and *Lock*," would on the fourth of December, form the subject of a concluding paper on the Rifle, brought the meeting to a termination.

DESCRIPTION OF A NEW CONSTRUCTION OF HIGH PRESSURE STEAM BOILER.

By Mr. J. Frederick Spencer, of London.

This Paper is communicated with the view of contributing to the general experience in generating steam of high pressure, say of 200lbs. per square inch, and in the belief that whilst the economy of more extended expansion is fully admitted, a safe, durable, and economical generator for high pressures is still a great desideratum.

The boiler which this paper refers to, the invention of Mr. Martin Benson, of Cincinnati, U.S., and some others, was invented and worked in America in the year 1852, and applied to work the steam pump of a fire engine—lightness and rapid generation being the chief requirements; and in December, 1856, the principle of mechanical circulation, one of the chief features of the boiler, was introduced, and there are now about 45 of them working satisfactorily in America, 10 being attached to stationary engines, and 35 to steam fire engines.

A boiler capable of safely generating steam of 200 to 300lbs. on the square inch, which has been so successfully and extensively in operation, it was thought, would be considered not unworthy the notice of the Members of this Institution.

Safety, durability, and economy are the great requirements in a steam boiler. And practical engineers know too well by experience that, whilst it is not difficult to accomplish either of these singly, the combination of the three is extremely difficult, and especially where the steam to be generated is of very high pressure.

Among the various boilers that have been constructed for generating steam of very high pressure, the small tubular form has been mostly adopted, as being the strongest with the least weight of metal, and as also possessing the additional advantages of giving the largest heating surface in a given space, and containing almost a minimum quantity of water.

One of the most important functious of a steam boiler is regular, uniform, and constant circulation of the water ;—so that as soon as the steam is formed it shall pass without delay into the steam chamber, and the space it occupied be immediately refilled with water. If from any cause this natural action is impeded, two injurious consequences result: namely, reduced evaporation and premature destruction of the conducting metal. It has been found that in land and marine boilers, in which there is always such a large amount of water in the boiler compared with the quantity evaporated, there is generally very defective circulation, as evidenced by slow evaporation and rapid destruction of the conducting metal.

In generating steam within small tubes containing a small amount of water, any deficiency of the feed may leave the tubes without water, in contact with a high temperature, and interrupt the proper circulating action so necessary in generating steam.

The uncertainty of what may be termed natural circulation, led to the invention and introduction of that which forms the distinctive feature of the boiler now to be described. Mechanical circulation, by which ten to twenty times the quantity of water required for steam may be passed through the boiler within a given time.

There is a furnace with a series of tubes of about 1in. or 1½in. in diameter and of any convenient length—these tubes are enclosed within a brick casing—they are covered in at the top by what may be called the uptake, and the chimney. Alongside and secured to the casing is a cylindrical receiver, which is connected direct to the upper portion of the tubes by means of pipes, and by means of another to the circulating pump, and also by means of a pipe to the lower portion of the tubes.

The boiler is divided into six distinct vertical sections; each of these sections is separately connected below to a common feed or circulating pipe, communicating direct by the valve box and pipe, with the circulating pump, and above to the receiver pipe, is also fixed between the receiver and the common feed or circulating pipe, to allow the water in the receiver to pass into the tubes, when the pump is not working, and in starting the boiler.

The tubes and receiver are in the first instance partially filled with water pumped in by hand as in other boilers, the communication between the lower and upper portions of the tubes, and the receiver being open. The fire is then lighted, and as rapidly as the steam is generated in the tubes, it passes through them into the receiver, until the whole of the water is heated and sufficient steam is generated to work the circulating pnmp.

This pump is worked by a steam cylinder, is double acting, and of simple construction, having instead of the ordinary self-acting valves, a D slide valve without lap, and worked by an eccentric, so that its continnous action can be thoroughly relied on; and this arrangement has in practice given every satisfaction. It will be evident that a small amount of power is required to work these circulating pumps, as the pressure is almost equal on each side of the piston, so that whether that pressure is 100 or 500lbs. per square iuch, the friction only of the water has to be overcome in effecting the circulation. A boiler of 100 nominal horse power would reqnire a circulating pump of only 7in. diameter, and 12in. stroke, making 50 revolutions per minute. In addition to the circulating pump there is the ordinary feed pump attached to it to supply the deficiency caused by the evaporation, and the ordinary feed pipe may either be connected to the circulating pnmp, to the receiver. The water-guage is fixed on the receiver, and indicates the height of water in it for the regulation of feed.

As soon as sufficient steam is generated to work the circulating pump (which in ordinary cases occupies about 20 minutes from cold water), the full working action of the boiler commences; and supposing 10 cubic feet of water is evaporated per hour, about 100 cubic feet per hour are passed through the circulating pipe, and the tubes by the circulating pump. This 100 cubic feet is discharged from the upper portion of the tubes into the connecting pipe, and thence into the receiver as mixed water and steam; the water falling to the bottom of the receiver, and the steam remaining in the upper portion or steam space.

It might be supposed that the steam would not be separated from the water with sufficient rapidity, and that very wet steam would be supplied; but practice and experience have proved that this is not the case; the separation is both rapid and distinct, and even when the water in the receiver has been allowed to rise to within a few inches of the top, the steam obtained has been found quite as free from water as that usually snpplied by ordinary land boilers.

Each section of the boiler has its own separate connection with the receiver, and the common circulation pipe, and the flow of water through the latter connections is regulated to any extent, either by simple contractions, or by cocks or valves, the former however are preferred.

There are also cocks or stop valves at the top of each of the connections to the receiver, so that any section of the boiler may be shut off in case of injury without in any way affecting the efficient working of the remaining sections.

This is a most important feature of safety, and provides for easy repair either at the time of injury, or at any snbsequent period where convenient.

The tnbes are screwed with a right and left-handed thread, so as by one movement to draw the two end bends together; and by this plan the union of the tubes in each section is performed without difficulty. Each section of tubes can expand to any extent, being suspended on vertical plates by a small lug on each bend rivetted to them.

For sweeping, cleaning, or removing either of the sections, hinged doors are placed in front of the boiler, thus giving easy access at any time to any or all portions of the tubes.

These boilers have been made both with brick casings and water space castings, but the former plan is preferred on account of ecouomy of first cost, safety, and improved combustion;—when the casing is a water space it may form the receiver.

There is also a distinct section of tnbes for superheating or drying the steam after it has left the receiver.

The general construction and working action of the boiler having been described, a few remarks may be added as to safety, durability, and economy.

1. SAFETY.—There can be no question of the great strength of small cylindrical tubes of 1 or 1½in. in diameter; the receiver also not being acted on by any high temperature, can be maintained in full strength for almost any period.

In consequeuce of the small amount of water in the tubes, bnt little injury could arise from their rupture; and the receiver being removed from any external source of heat, could not, in the event of its bursting, produce that dangerous percussive action resulting from the sudden release of highly heated water in a heated flue.

Another element of safety is the facility with which any injured section can be disconnected.

2. DURABILITY.—The only part of the boiler subject to great heat is the lower portion of the tubes; and it will be readily seen that the strong cnrrent supplied by the circulating pump, tends not only to prevent deposit, but also any injury arising from want of water in the tubes.

The tubes iu one of these boilers that had been in constant work for eighteen months, with water largely impregnated with lime and other impurities, were found, on examination of several of them, to be perfectly free from scale;—any deposit passing into the receiver, from which it was easily removed.

In order to ascertain the effect of working these boilers with salt water, some experiments have been made on one constructed in Newcastle by Messrs. Hawthorn. This boiler was formed of wrought iron tubes—one inch inside diameter —and had about 340 square feet of heating surface and 9 square feet of grate surface. It was kept in constant operation for fourteen days and nights under a pressure of 80lbs. per square inch with salt water, having about $\frac{5}{33}$ or 15 per cent. of salt in it, a saltness greatly in excess of that considered safe in marine boilers. Upon examination the lower tubes were found with an internal scale of $\frac{1}{16}$ of an inch, whilst in the upper tubes a scale was hardly perceptible.

This experiment was made with the view of trying how much scale could be deposited under the most unfavourable circumstances, and the result clearly proved that with the ordinary saltness in marine boilers, the circulating system would enable these boilers to work safely for a lengthened period. Although it is not intended at present, to recommend them to be continnously worked with sea water, it is satisfactory to know, that where used in combination with surface condensation, any temporary cessation of the pure water supply cannot seriously affect them.

3. ECONOMY OF FUEL.—It is well known that efficient combustion, in conducting metal, large heating surface, and certain circulation, will give a large evaporative duty. The result of some experiments made in the United States in June last, gave an evaporative duty of 11lbs. of water per lb. of fuel; it is, however, but fair to state that these experiments were made under very unfavourable circumstances as to the working of the boiler.

4. ECONOMY OF WEIGHT.—It is in marine boilers especially that weight is objectionable—and it is proposed to compare an ordinary marine boiler with one of the same heating surface, constructed on this tubular and circular plan.

In each case the heating surface is 2000 square feet.

	New Boiler.	Ordinary Boiler.
Weight of boiler (including brick work) without water	22 tons.	20 tons.
Weight of water in boiler	2 „	19 „
Total weight of boiler and water	24 „	39 „

It will be thus seen that fully 40 per cent. of weight is saved; and in this comparison, the heavy brick casing has been included together with the receiver and connections.

5. ECONOMY OF SPACE.—Taking again the new boiler of 2000 square feet of heating surface, and an ordinary marine boiler having the same heating surface, we have as follows:—

	New Boiler.	Ordinary Boiler.
Floor area occupied	80 sq. ft.	130 sq. ft.
Cubic space do.	960 cub. ft.	1560 cub. ft.

This comparison is greatly in favour of the new boiler, showing a saving of fully 60 per cent. both in floor and cubic space occupied.

6. ECONOMY OF COST AND REPAIR.—As to the cost of construction, experience has proved that in all cases these improved boilers are made at a less cost than those of the ordinary tubular construction, and with reference to the cost of repair, it is almost entirely confined to the tubes and brick casing, and therefore cannot be serious in amonnt.

One other advantage has to be referred to in these boilers in comparison with those in general use, namely, rapidity in raising steam from cold water.

In October, 1858, some interesting experiments were made at St. Louis, United States, to test seven steam fire engines, six of which had boilers on the circulatiug principle. In these six the steam was raised to 60lbs. from cold water within six minutes. This is easily accounted for by the small body of water acted upon by the fire; but in general practice it is considered advisable to have a larger reserve of water, so that from twenty to forty-five minutes may be necessary to raise steam. As the result of actual experience, the following proportions have been arrived at for efficient generation:—

FOR LAND BOILERS.—Having 200 to 1000 sqnare feet of heating surface, there should be one cubic foot of steam and water space to every 22 square feet of heating surface; whilst in boilers having above 1000 square feet of heating surface the proportion should be 1 to 25.

FOR MARINE BOILERS.—The proportion of steam and water space to the heating surface should be 1 to 27.

DYNAMOMETRICAL EXPERIMENTS ON THE SCREW PROPELLER.

Communicated by Admiral Paris, C.B., Imperial French Navy.

This is an abstract of experiments made by M. Taurines, at Brest, in 1848, (from 13th June, to 21st July), on board of a boat fitted with an engine of two horse power; the purpose of these was the study of a method of trial, which has been practised afterwards on a larger scale. With a dynamometre of rotation, the number of kilogrammetres transmitted by the shaft, were directly measured with great exactness. A second dynamometer, gave the measure of the thrust of the screw and with the speed of the boat, all elements of the efficiency are known. So 50k. thrust 2 metres per second, and 150m., kilogrammetres, for the work of engine, the efficiency will be $\frac{50^{\cdot} \times 9\text{km.}}{150\text{m.}} = 0{\cdot}66.$

This method is based on direct measures, and makes no use of arbitrary co-efficients; it is more exact than any other method of study on the screw propeller, and it gives the real mechanical value of the propeller.

During these various experiments, they have traced nearly 5,000 metres of curves, which have been measured with a planimeter, and gave the real thrust at the power of rotation. These experiments have been made with more than 40 screws, showing a remarkable variety of pitch, diameter, fraction of surface, and number of blades.

The screws were of cast brass, as they are generally made, exactly fitted, and made true with the utmost care on a lathe disposed for that purpose. The pitches varied from 0·535m., to 1·400m., and the diameter from 0·475m., to 0·640m.

The steam engine was a high pressure one, and with gearing: the main wheel had 90 teeth. The pinion on the screw shaft was not in gear with this wheel, but with an intermediate one. This disposition, though complicated, had the advantage of allowing the change of the pinion for each screw. There were 10 of these, from 20 to 40 teeth, having each a difference of two teeth, so that each stroke produced from 2¼ to 4½ turns of the screw. Thus, the steam engine was preserving the same speed during all experiments, and this regularity of motion and of power threw a great light on these experiments, and it shews immediately the superiority of some screws.

The experiments of M. Taurines were made with screws of the common form. The numerous calculations were made under his direction and frequently verified. They were performed at his own expense, when he was Professer of Mathematics at Brest, and since that time he has much improved the dynamometers after long studies on the springs and their proprieties.

The constitutive elements of the screw propeller are the pitch, the diameter, the number of blades and the fraction of surface of helicoid, that is the sum of blades.

TABLE I.—INFLUENCE OF THE PITCH.

First Group.—Screws of two Blades.—Fraction of Surface, 0·25; Diameter, 0·535m.

Indication of Screw.	Pitch. M.	Number of turns per second.	Slip.	Efficiency.
S	0·804	4·255	0·416	0·616
X	0·914	3·694	0·433	0·585
A C	1·060	3·313	0·474	0·545
A H	1·209	3·185	0·505	0·487

Second Group.—Screws of two Blades.—Fraction of Surface, 0·33; Diameter, 0·535m.

Indication of Screw.	Pitch. M.	Number of turns per second.	Slip.	Efficiency.
Q	0·711	4·148	0·362	0·665
A B	1·056	3·345	0·453	0·556
A C	1·212	3·012	0·484	0·517
A K	1·399	2·808	0.522	0·460

Third Group.—Screws of two Blades.—Fraction of Surface, 0·50; Diameter, 0·535m.

Indication of Screw.	Pitch. M.	Number of turns per second.	Slip.	Efficiency.
A N	0·536	4·777	0·239	0·681
P	0·717	4·021	0·330	0·662
R	0·799	4·011	0·349	0·649
V	0·902	3·539	0·380	0·594

Fourth Group.—Screws of two Blades.—Diameter, 0·640m.

	Fraction of Surface.	Pitch.	Turns per Second.	Slip.	Efficiency.
A R	0·136	0·713	4·078	0·326	0·698
A V	0·140	1·028	3·245	0·423	0·659
A Q	0·249	0·705	4·007	0·278	0·717
A S	0·252	1·061	2·807	0·370	0·638

(*) In all these calculations the speed is not measured in miles, but in metres per second, and half a metre per second is quite a knot. The power instead of being counted in horses, is expressed in kilogrammetres, that is one kilogramme hoisted one metre per second. is equal to 7·243, foot pound, or a foot pound = 0·138 kilogrammetres.

Fifth Group.—Screws of four Blades.—Fraction of Surface, 0·25; Diameter, 0·535m.

Indication of Screw.		Pitch. M.	Turns per Second.	Slip.	Efficiency.
U	——	0·809	4·009	0·380	0·640
A F	——	1·085	3·181	0·457	0·560
A J	——	1·189	3·226	0·491	0·519
A M	——	1·388	2·928	0·524	0·500

Sixth Group.—Screws of four Blades.—Fraction of Surface, 0·33; Diameter, 0·535m.

Indication of Screw.		Pitch. M.	Turns per Second.	Slip.	Efficiency.
A E	——	1·054	3·232	0·429	0·590
A I	——	1·216	2·983	0·472	0·554
A L	——	1·367	2·807	0·498	0·123

Seventh Group.—Screws of four Blades.—Fraction of Surface, 0·50; Diameter, 0·535m.

Indication of Screw.		Pitch. M.	Turns per Second.	Slip.	Efficiency.
T	——	0·799	3·742	0·321	0·692
V	——	1·878	3·541	0·343	0·643
A D	——	1·050	3·065	0·385	0·608

TABLE II.—INFLUENCE OF DIAMETER.

Indication of Screw.	Surface. M.	Pitch. M.	Diameter. M.	Turns per Second.	Slip.	Efficiency.
Q	0·293	0·711	0·535	4·148	0·362	0·665
A P	0·346	0·692	0·641	0·765	0·213	0·738*
D	0·256	0·697	0·477	4·889	0·457	0·552
A Q	0·269	0·705	0·642	4·007	0·278	0·717
A C	0·250	1·060	0·536	3·313	0·474	0·545
A S	0·252	1·061	0·642	2·807	0·370	0·638

* This screw gives the best results of all experiments.

TABLE III.—INFLUENCE OF THE NUMBER OF BLADES.

Screws with 2 and 4 blades Diameter, = 0.535m.

Indication of screws.	Number of blades.	Surface.	Pitch.	Turns per second.	Slip.	Efficiency.
S	2	0·251	0·804	4·25	0·416	0·616
U	4	0·255	0·809	4·01	0·380	0·640
R	2	0·499	0·799	4·01	0·349	0·649
T	4	0·509	0·799	3·74	0·321	0·692
A C	2	0·250	1·060	3·313	0·474	0·545
A F	4	0·257	1·085	3·181	0·457	0·560
A B	2	0·337	1·056	3·345	0·453	0·556
A E	4	0·341	1·054	3·232	0·429	0·590
A H	2	0·253	1·209	3·185	0·505	0·487
A S	4	0·253	1·189	3·226	0·491	0·519
A G	2	0·336	0·212	3·012	0·484	0·517
A I	4	0·335	1·216	2·983	0·472	0·554
A K	2	0·333	1·399	2·808	0·522	0·460
A L	4	0·343	1·367	2·807	0·498	0·523

Screws having the same Diameter, 0·475m.

Indication of screws.	Number of blades.	Surface.	Pitch.	Turns per second.	Slip.	Efficiency.
A	2	0·660	0·715	4·342	0·376	0·589
I	4	0·665	0·717	4·240	0·358	0·627
M	6	0·670	0·718	4·277	0·335	0·663
B	2	0·501	0·708	4·536	0·386	0·598
J	4	0·501	0·711	4·613	0·379	0·624
N	6	0·502	0·710	4·678	0·370	0·651
D	2	0·256	0·697	4·889	0·457	0·552
H	4	0·240	0·750	4·662	0.454	0·570
L	6	0·249	0·735	4·767	0·441	0·623

In the last group the pitch of the screw is too short, and that of the two others is too long. Few screws of three and six blades, have been tried because of difficulties of construction.

TABLE IV.—INFLUENCE OF THE FRACTION OF SURFACE.

First.—Screws with two Blades.—Diameter, 0·535m.

Indication of screws.	Surface. M.	Pitch. M.	Turns per Second.	Slip.	Efficiency
Q	0·293	0·711	4·148	0·362	0·665
P	0·503	0·717	4·021	0·330	0·662
S	0·251	0·804	4·255	0·416	0·616
R	0·499	0·799	4·012	0·349	0·649
X	0·269	0·914	3·694	0·433	0·585
V	0·479	0·202	3·539	0·380	0·594
A C	0·250	1·060	3·313	0·474	0·545
A B	0·337	1·056	3·345	0·453	0·556
A H	0·253	1·209	3·185	0·505	0·487
A G	0·336	1·213	3·012	0·484	0·516

Second.—Screws with two Blades.—Diameter, 0·640m.

Indication of screws.	Surface. M.	Pitch. M.	Turns per Second.	Slip.	Efficiency
A R	0·136	0·713	4·078	0·327	0·698
A Q	0·249	0·704	4·007	0·278	0·717
A P	0·334	0·692	3·765	0·213	0·738*
A U	0·140	1·028	3·245	0·423	0·658*
A T	0·166	1·078	3·137	0·419	0·643
A S	0·252	1·061	2·807	0·370	0·639

* Pitch too short.

Third.—Screws with four Blades.—Diameter, 0·535m.

U	0·255	0·809	4·009	0·380	0·640
T	0·509	0·799	3·742	0·223	0·684
A F	0·257	1·085	3·181	0·457	0·560
A E	0·341	1·054	3·232	0·429	0·589
A J	0·253	1·189	3·226	0·491	0·520
A I	0·335	1·216	2·983	0·472	0·554
A M	0·252	1·383	2·928	0·523	0·500
A L	0·343	1·367	2·807	0·498	0·523

M. Taurines tried three screws with speeds of 1·50m., and of 2m.; for the first ones the observations were crossed, that is to say that they worked alternately at full and little speed, so the observations were identical.

Let V and V′ be the little and great speeds, F and F″ the thrust corresponding these speeds. $H = \frac{F}{V^2}$ and $H = \frac{F'}{V^2}$

To find under an emperical form the law of resistance, let us put $F = A V m.$, $F' = A V' m.$ So we shall have; $H = A V m^2.$, and $H' = A V' m^2.$, and from that $\left(\frac{V'}{V}\right) m^2 = \frac{H'}{H}$ We should deduce the value of $m.$, with the quantities V V′ H and H′, which are given by the abstractions.

First.—Screw N, with six Blades.—Diameter, 0·476; Pitch, 0,710m.; Surface, 0·502m.

	Turns per second.	Slip.	Efficiency.	Val. of A. kilo.	Value of M.
V =1·5554·H =10,956	3·411	0·357	0·642	8·4275	2·594
V′=2·0824·H′=13,032	4·837	0·394	0·618		

Second.—Screw F, with three Blades.—Diameter, 0·476m.; Pitch, 0·725; Surface, 0·503m.

V =1·6297 H =10,840	3·648	0·363	0·610	8·2986	2·547
V′=2·0993 H′=12,453	4·825	0·386	0·592		

Third.—Screw P, with two Blades.—Diameter, 0·536m.; Pitch, 0·717; Surface, 0·503.

V =1·6531 H =11·428	3·366	0·315	0·634	8·3177	2·632
V′=1·9953 H′=12·873	4·244	0·345	0·623		

RECAPITULATION.

Screws.	Value of A. kilo.	Value of M.	Differences of the means of M.
N	8·4275	2·594	+ 0·001
F	8·2986	2·547	— 0·017
P	8·3177	2·632	+ 0·015
Means	8·3479	2·591	

The above experiments show that the resistance of the ship increases more rapidly than the ratio of the square of speed. Its algebraical expression which is represented by a single term, ought, in reality, to contain several, with powers expressed by numbers, which can be obtained by this method.

Secondly, the comparison of the resistances of the screw P having 0.536m. of diameter, and the screws N. and F., which have only 0·476, and whose consequent surfaces are as $\overline{0·536}^2$ to $\overline{0·476}^2$ that is to say, 1·27, shows that the wideness of the propeller has no sensible influence on the resistance of the ship.

At least it will be remarked that the efficiency remains quite the same when the speed increases in the proportion of 3 to 4.

INTERPRETATION OF THE ABOVE TABLES.

The examination of the various groups of the first table, shows that in every case, and without any exception, the efficiency lessens when the pitch increases. So considering the extremes, it will be seen that the pitch having varied from 0·535 m., to 1·400 m., the efficiency of the screws of the same diameter, is lessened from 0·68 to 0·46.

The three trials of table 2nd, are more than sufficient to show the advantage of screws of a large diameter The efficiency is thus much increased, and the number of revolutions is lessened.

According to table 3rd, the four bladed screw is certainly superior to that having but two blades; but the advantage is not decided enough to neglect the second, (that is two blades), which has the advantage of being twisted in a trunk.

Lastly, the 4th table shows how much the surface of the screws can be reduced, (see the screws A. B. and A. U., whose friction surface is from 0·136, to 0·140), without damaging the efficiency. It is not exactly the same for the regularity of the mechanism, and the inspections of dynamometrical diagrams have shown though it was preferable to use screws with 4 and 6 blades, with surface wide enough.

It is well understood that these considerations are not absolute, for it would be too bold to establish definitive conclusions, when acting from a small scale of experiments, to the large one of real service.

EXPERIMENTS AT MOORINGS.

Each screw has been tried when the ship was moored on shore, by the stern, and besides the helicometer they used a dynamometer on the hawser, to verify several times the indications of the dynamometer of thrust, whose exactness has been tested in that way. These experiments proved a fact which had been observed in previous trials, and which is this:—

If the thrust is designated by f, the pitch of the screw by h and by f' the useful work or power transmitted to the shaft, (the friction of the screw shaft and of the thrust block being deduced, which is for both of little importance, and easier to calculate than for any other part), we shall find that the relation $\frac{f\,h}{f'}$ far from being smaller than one, is generally a a little more, and for one of the screws it has been 1·12.

On examining the whole experiments it will be perceived that the pitch and diameter has not a sensible influence on this proportion; but if comparing in a proper manner some of those experimented screws, they will find the element which has a tendency to increase it.

DYNAMOMETRICAL EXPERIMENTS MADE IN 1848.

First Group.—Screws with two Blades.

Screws.	Surface. M.	Pitch. M.	Diameter. M.	Turns per second.	$\frac{f\,h}{f'}$
A P	0·344	0·692	0·642	2·835	1·024
A Q	0·249	0·705	0·642	3·024	1·058
A R	0·136	0·713	0·640	3·574	1·100
Second Group.—Screws with two Blades.					
A S	0·252	1·061	0·642	2·272	0.996
A T	0·166	1·078	0·642	2·605	1·079
A U	0·140	1·028	0·642	2·823	1·122

It will be seen that the rotation $\frac{f\,h}{f}$ increases when the friction of surface lessens. Is it the true cause of these variations, and are they not to be attributed to the celerity of rotation or to the small surface of the blade? To know that let us form new groups.

Screws.	Number of blades.	Surface.	Pitch. M.	Diameter.	Turns per second.	$\frac{f\,h}{f'}$	Wideness of the blade.
Third Group.							
A	2	0·660	0·715	0·476	3·324	0·972	0·330
E	3	0·674	0·696	0·475	3·398	1·994	0·224
I	4	0·665	0·717	0·477	3·367	1·010	0·166
M	6	0·670	0·718	0·476	3·368	1·048	0,111
Fourth Group.							
B	2	0·501	0·708	0·476	3·568	0·969	0·250
F	3	0·503	0·702	0·476	3·568	0·995	0·187
J	4	0·501	0·711	0·475	3·569	1·008	0·129
N	6	0·502	0·710	0·476	6·690	1·018	0·083
Fifth Group.							
D	2	0·256	0·697	0·477	4·168	1·029	0·128
H	3	0·240	0·750	0·476	4·013	1·056	0·080
L	4	3·249	0·734	0·477	4·089	1·065	0·061

It has been useless to make more examples to show that the increase of the relation $\frac{f\,h}{f'}$ is not produced by the accelleration of rotation, nor by the lessening of the surface of the screw, but really by the smallness of the blade.

Now, is this relation $\frac{f\,h}{f'}$ the same when making a free way, and when moored to the shore? Great differences are remarked when the slip is small as 0·20, 0·30, and the wind produces many errors.

About this subject, we can give some of the experiments made with peculiar instruments of M. Taurines', fitted on board of the sloop of war *Primauguet*, 400 nominal horse power.

First.—Common Screw with five Blades.—Diameter, 4·00m.; Outer pitch, 9·75m.; Fraction of surface, 0·41; Fraction for one blade, 0·082.

	Turns per minute.	Speed of the ship. M.	Slip.	Efficiency.	$\frac{f\,h}{f'}$
29th Oct., 1856.	41·25	5·080	0·242	0·545	0·719
Ditto	44·50	5·445	0·247	0·560	0·744
Screws with two treble blades.*—Diameter, 4m.; Outer pitch, 9·75m.; Fraction of surface, 0.20; Fraction of blade, 0·033.					
28th Nov., 1856.	46·44	4·874	0·315	0·55	0·803
1st December	40·39	4·498	0·282	0·55	0·766
Ditto	52·24	5·506	0·313	0·61	0·887
4th December	47·88	4·724	0·356	0·58	0·901

At the moorings the screws whose blades are so small, would give for that relation a much greater value, as has been proved by experiments made on board the *Primauguet*, the 15th February, 1854, with a screw having five blades.

* This is what is called in France, Mangin's screw. Suppose a two-bladed screw sawed in two or three equal parts, in a direction perpendicular to the anis, and then all the parts, turned a little and placed one before the other in the same plan. This screw gave good results when of sufficient surface, it is very narrow as well as the trunk to hoist it. When having treble blades it does not work well when backing the way.

	Turns per minute. N	Power in horses of 75k.	Corrections for the difference of the shaft and thrust block.	Difference. F	Thrust. f	$\frac{f}{f'} = \frac{1}{4500} \frac{Nf}{F}$
1	39·3	576·9	15·70	561·20	7475	0·11633
2	42·3	668·1	17·36	650·74	8050	0·11629
3	43·3	695·8	17·95	677·95	8275	0·11747
4	43·0	682·0	17·73	664·27	8150	0·11726
5	43·5	707·7	17·92	689·80	8130	0·11394
6	43·25	700·7	17·80	682·90	8130	0·11444

Mean $\frac{f}{f'} =$ 0·11595

Multiplying this pitch by the outer pitch, 9·75, they have $\frac{fh}{f'} = 1{,}130$.

Dynamometer of Rotation.

This excellent instrument measures the power of rotation on the shaft itself, and inscribes it constantly with a pencil, tracing an endless diagram of great regularity, though showing great difference according to the inequalities of the resistance of the screw when it passes between the stern posts, and especially those of the power itself, because the expansion, and the relative position of the cranks, give a very unequal rotatory power.

The above mentioned dynamometer measures the true *duty* of the shaft of steam engines from 2 to 740 horses of 75km., and since it has been fitted to engines of 950 nominal horse power. But let us see the result of this instrument on the engines of the *Primauguet* (*) made by Mazeline, and of 400 nominal horse power.

First.—Experiments of 1854.—(General Meaus).

Number of diagrams observed.	Number of revolutions per minute.	Number of horses of 75k. measured on the screw shaft.	Duty.	
17	50·28	731	0·800	When making free way.
18	50·83	748	0·837	
6	42·43	672	0·741	At the mooring on shore.

Second.—Experiments of 1856.

Number of strokes per minute.	Number of horses of 75k. measured on on the shaft.	Duty.	
41·25	427·5	0·830	Common screws with five blades.
44·50	558·7	0·850	
46·44	485·6	0.830	Screw with two treble blades.
40·89	319	0·760	
52·24	653	0·830	
47·88	523	0·840	

The experiments of steam-tug *Elorn* gives 0·80 for the efficiency of an engine whose power is 70 horse power of 75 kilogrammetres.

Dynamometer of Impulse.

This instrument is fitted on the thrust block, and measures the impulse by an endless diagram traced by the pencil when the first one gives the the power of rotation at the same moment. Thus all data are collected together, and in a very exact manner.

By observations made with this instrument, and with the speed measured by a base on the shore, or with buoys, it has been found that the resistance of the ship increases as the power : 2·56 of the speed.

(*) The engine of *Primauguet* is direct, with four cylinders; the pair a-head and that abaft, have their cranks at right angles, but the two pairs are connected to each other at 45°. Air pump, double acting, having the same stroke as steam piston.

INSTITUTION OF CIVIL ENGINEERS,

November 8, 1859.

Joseph Locke, Esq., M.P., President, in the Chair.

Previous to commencing the proceedings, Mr. Locke, M.P., President, rose and said:—

I cannot permit the occasion of opening a new Session to pass without alluding to the irreparable loss which the Institution has sustained by the death, during the recess, of its two most honoured and distinguished Members.

In the midst of difficulties of no ordinary kind, with an ardour rarely equalled, and an application, both of body and mind, almost beyond the limit of physical endurance, in the full pursuit of a great and cherished idea, Brunel was suddenly struck down, before he had accomplished the task which his daring genius had set before him.

Following in the footsteps of his distinguished parent, Sir Isambard Brunel, his early career, even from its commencement, was remarkable for originality in the conception of the works confided to him. As his experience increased, his confidence in his own powers augmented; and the Great Western Railway, with its broad guage line, colossal engines, large carriages, and bold designs of every description, was carried onward, and ultimately embraced a wide district of the country. The same feeling induced, in steam navigation, the successive construction of the "Great Western" steamer, the largest vessel of the time, until superseded by the "Great Britain," which, in its turn was eclipsed by the "Great Eastern," the most gigantic experiment of the age.

The Great Ship was Brunel's peculiar child: he applied himself to it in a manner which could not fail to command respect; and if he did not live to see its final and successful completion, he saw enough, in his later hours, to sustain him in the belief that his idea would ultimately become a triumphant reality.

The shock which the loss of Brunel created was yet felt, when we were startled by an announcement that another of our esteemed members had been summoned from us.

Of that friend, I feel it to be a difficult task to speak without giving way to feelings better fitted for the closet than a public assembly. Robert Stephenson was the friend of my youth, the companion of my ripening years, a competitor in the race of life; and was as generous as a competitor, as he was firm and faithful as a friend. This will, I know, find an echo in the hearts of all around me; and your feelings will supply that laudation in which it would seem inappropriate for me to indulge.

Like Brunel, Robert Stephenson commenced his professional career under his father, George Stephenson. His early years were devoted to the improvement and construction of the locomotive, and to him we owe the type of those machines, many of which are now actually in use on our railways.

From the time of the Liverpool and Manchester Railway—when our joint report contributed in a great degree to the adoption of the locomotive engine as the means of transport,—and of the subsequent London and Birmingham Line, with its long parliamentary contests, it Kilsby Tunnel, and other difficulties inherent in so new an undertaking, a multitude of other lines followed, in which there had to be foreseen and provided for, numerous difficulties, all of which were met and surmounted with coolness and consummate skill,

Among these great works may be mentioned the Royal Border and High Level Bridges, and more especially the Conway and Britannia Bridges, which were the first examples, on so vast a scale, of the tubular principle, and the bridges across the St. Lawrence and the Nile, remarkable alike for their grandeur of conception and successful execution.

To my present hearers, the enumeration of the works in which Robert Stephenson was engaged would be a "twice-told tale;" but we must look back with interest upon the days of the "Battle of the Gauges"—the discussions upon the atmospheric system— and the numerous topics which have been argued within these walls and elsewhere.

In the enjoyment of a distinguished name and reputation, Robert Stephenson, like Brunel, has been cut off while still in the middle period of life; and although he pursued his profession with persevering energy, and accomplished in it those triumphs of the successful application of a mind well trained and stored with practical and theoretical knowledge of various kinds, and achieved some of the greatest works of art which have been witnessed in our day, he at the same time obtained an eminence in the scientific world, rarely reached by any practical professional man.

It is not my intention, at this time, to give even an outline of the works achieved by our two departed friends. Their lives and labours, however, are before us, and it will be our own fault if we fail to draw from them useful lessons for our own guidance. Man is not perfect, and it is not to be expected that he should be always successful:—and, as in the midst of success we sometimes learn great truths before unknown to us, so also we often discover in failure the causes which frustrate our best directed efforts. Our two friends may probably form no exception to the general rule: but judging by the position they had each secured, and by the universal respect and sympathy which the public has manifested for their loss, and remembering the brilliant ingenuity of argument, as well as the more homely appeals to their own long experience often heard in this hall, we are well assured that they have not laboured in vain. We, at least, who are benefited by their successes, who feel that our Institution has reason to be proud of its association with such names as Brunel and Stephenson, have a duty to perform, and that duty is to honour their memory and emulate their example.

I ought to add, in conclusion, that amongst the many private and public bequests made by Robert Stephenson, is one to this Institution of the munificent sum of Two Thousand Pounds.

ON THE PROCESS OF RAISING AND HANGING THE BELLS IN THE CLOCK TOWER, AT THE NEW PALACE, WESTMINSTER.

By Mr. Jabez James, Assoc. Inst. C.E.

It was stated that the first large bell, which weighed upwards of 15 tons 18 cwt., and was cast by Messrs. Warner and Co., at Norton, near Stockton-on-Tees, was fractured while suspended from a staging at the base of the tower, during the course of experiments on the tone of the bell. The fracture took place on the opposite side from where the bell was struck by the clapper, which weighed 12 cwt. It passed from the lip through the sound bow, and extended up the waist of the bell, and was about 40 inches in length from the lip. The fracture seemed to be clean, and the metal had a coarse dull appearance, and was full of minute holes, which were noticed in other parts of the bell, when it was afterwards broken up.

The four quarter bells were also cast by Messrs. Warner, but the third having been condemned as defective, had to be recast. The first, weighing rather more than 1 ton 1 cwt., was lifted in three hours; the second, weighing upwards of 1 ton 5 cwt., occupied three hours and a half; and the third, which weighed above 1 ton 13½ cwt., took four hours. These three bells were raised by means of a single chain, made of bars 7–8ths of an inch diameter, and a crab with a double purchase. The fourth quarter bell, weighing more than 3 tons 17½ cwt., was lifted in six hours, by a similar chain, reeved through a single pulley, and by a double purchase crab. These bells were hung at the four angles of the tower, around the large bell, for the convenience of sounding, &c.

The second large bell weighed upwards of 13½ tons, and was cast by Messrs. Mears, at Whitechapel. The best method of raising this bell in a safe and economical manner having been carefully considered, it was decided to use a treble-purchase crab, with large blocks and fall. A new chain, made by Messrs. Hawks, Crawshay, and Co., 1,500 feet in length, and tested to a strain of 10 tons, was employed. This chain, when reeved through two three-sheave blocks, and with a standing chain, gave a power equal to about 70 tons. As the bell was 9 feet in diameter at the sound bow, and 7 feet 10½ inches in height, and the dimensions of the tower were only 8 feet 6 inches by 11 feet 1 inch, it was not possible to lift it by the crown, with the mouth downwards. Consequently, a cradle had to be constructed in which the bell should rest on its side. Friction rollers were attached to the cradle at the top and at the bottom, which served as guides, and rubbed against balks of timber set upright iu the shaft. The upper block was made fast, by a shackle and clip, to a flitch beam formed of two plates of iron fixed between six timbers; and the lower block was firmly secured to the cradle by massive bolts and straps. The treble-purchase crab was fixed to a strong staging in the cast-iron lantern at the top of the tower, in such a position as to leave a distance of about 19 feet between the bottom of the crab and the crown of the bell, when the latter was raised to its proper position. As the single barrel of the crab could not take up all the chain without incurring the risk of surging, consequent upon the coiling of the chain in so many thicknesses, several lifts were made, as stated in a tabular statement given in an appendix, in which was also recorded the time occupied for each lift, and the fleeting of the chain. An iron chain stopper of special construction was made for the purpose of holding the chain during the fleeting on the drum of the crab. The weight of the bell and the cradle and iron work, together with chaiu, blocks, &c., was about 25 tous exclusive of friction. The process of raising commenced at 6 o'clock iu the morning, and continued, without intermission, until noon the following day, when the bell was safely landed on a staging in the clock room. The cradle was then disconnected, and the bell was turned over with the crown upwards. An eye-bolt was passsd through, and being now clear of the shaft, the bell was lifted in the usual way from the clock room to the bell chamber. The total height the bell was raised was 201 feet 3¼ inches, at an average velocity of about 6 feet 5 inches per hour.

The paper then procceeded to state the experiments that had been made before the weight of the hammer and the distance it should fall through, were finally settled. The weight was decided to be 6 cwt. 3 qrs. 10 lbs., with a fall of 13 inches. This arrangement for striking the hour was continued uutil the bell was discovered to be fractured in two places. One of the cracks was precisely in the same position in this bell as in the former one, exactly opposite to the place where it was struck by the hammer, and the other was about 2 feet away from it. The first fracture appeared to be about 15 inches and the secoud about 24 inches long; but they did not extend through the thickness of the metal, uor withiu two or three inches of the lip at present.

The whole of the works for raising the bell were carried out by Hart, assistant to Mr. James, under the superintendance of Mr. Quarm, Clerk of the works at the New Palace.

In the discussion, it was remarked, that the composition of the metal of the bell was not the same as that usually adopted in this country or on the contiuent, there being a greater proportion of tin than was customary. It was also thought, that the use of charcoal-smelted copper, as was the case in Russia, was advantageous. It was suggested, whether the interval between the blows of the hammer might uot have been too short, and whether the chattering of the hammer, due to its not being cleared immediately immediately after striking, might not have a tendancy to produce numbness, and hence stun the bell and contribute to its fracture. It was urged that the great weight and fall given to the hammer must have acted prejudicially. These were supposed to be rendered necessary by the thickness of the metal, which had been made considerable, in order to guard against accident; but it was coutended that it had a contrary tendency.

November 15, 1859.

George P. Bidder, Esq., Vice-President, in the Chair.

ON THE ORIGIN, PROGRESS, AND PRESENT STATE OF THE GOVERNMENT WATER WORKS, TRAFALGAR SQUARE: WITH A FEW FACTS RELATING TO OTHER WELLS WHICH HAVE BEEN SUNK, OR BORED INTO THE CHALK FORMATION.

By C. E. Amos, M. Inst. C.E.

The author commenced by stating that, a good supply of water having been required for the fountains in Trafalgar-sqnare, it was determined, in the year 1843, to carry out a plan which had been suggested by Mr. James Eastou. This was so framed as to include the water supply for the public offices. The water was to be obtaiued aud raised by engine power, from the springs beneath the Londou clay. The quantity of water required for condensing the steam of the engine being too great to be taken from the main spring, in full quantity, it was considered expedient to use cooling ponds; and it was thought that a small quautity of water iu excess of that required for the public offices, running continually into the cooling ponds, would keep the water clean, and in a state fit for the purpose of condeusation. The basins of the fountains were intended to form the cooling ponds. The water from them was to be taken for the use of the condenser, afterwards to be raised into a cistern, from whence it was to be conveyed to, and be passed through the jets of the fountains, where, meeting with the resistance of the air, it would be partially cooled and returned to the basin, for further circulation.

Estimates having been made, it was found, that the yearly interest on the cost of erection, added to the cost of working, would be less than the sums hitherto paid annually for the water supply to the public offices, and that, consequently, the playing of the fountains could be effected without cost to the government. A contract was then made with Messrs. Easton and Amos for the execution of the works; and a piece of ground having been selected in Orange-street, the works were commenced in January, 1844, by sinking the first well to the depth of 174 feet. A cast iron pipe, 15 inches diameter, was then driven through 30 feet of plastic clay, and 10 feet into a stratum of gravel, sand, and stones, being left standing several feet up in the well. Within this another pipe of 7 inches diameter was driven through 35 feet of green coloured sand, and 3 feet into the chalk formation, and the boring was then continued to the total depth of 300 feet from the surface. A considerable quantity of water came from the sand, but a much larger supply was obtained from the chalk. A second well was sunk in the enclosure, immediately in front of the National Gallery, to a depth of 168 feet from the surface. A pipe, 14 inches diameter, was then driven through the plastic clay, and into the gravel, sand, and stones beneath it. Within this a pipe 7 inches diameter was driven through 42 feet of green-coloured sand, and 3 feet into the chalk, the boring being continued to the total depth of 383 feet. The springs were found to be stronger than those in the well in Orange-street. A tunnel, 6 feet diameter and about 400 feet long, was driven to connect the two wells; the bottom of it being about 123 feet below T.H.W.M. A catch well, 5 feet 6 inches diameter and 32 feet deep, was sunk just outside the engine house. A tunnel was driven from it, passing beneath Castle-street and the National Gallery, to contain the pipes for bringing the water back from the basins of the fountains to the catch well.

The paper then proceeded to describe the situatiou of the different tanks, or reservoirs, in the water-tower, and their purpose; and next gave a brief account of the high pressure condensing steam-engine; on the Cornish principle, for working two sets of pumps, one being capable of raising one hundred gallons of water per minute from the springs to the tank. and the other five hundred and fifty gallons per minute from the catch well iuto the tank for condensation, and for the supply of the fountains. An auxiliary high-pressure single-acting steam-engine was also provided, to be used when the principal machine needed repair.

The works were finished in December, 1844. The total cost, as completed, amounted to nearly £8,400. The water rose to within 90 feet of the surface (about 48 feet below T.H.W.M.), and was found to be of good quality. When the engine was pumping 110 gallons of water per minute, it could only lower the water four feet in the well.

In 1846, a further demand for water having been made, a larger pump was substituted, which was capable of raising 350 gallons of water per minute from the springs.

In 1849, a second well was sunk in Orange-street, and an engine of 60 horse power, on Woolfe's principle, was erected. The well was carried to a depth of 176 feet, and a tuunel was driven to connect it with the other wells. A bore-pipe was driven through the plastic clay, within which it was intcuded to drive a smaller pipe through the sand into the chalk, and then to continue the boring as in the other wells. But an accident haviug occurred in driving the large pipe, which allowed saud to come up the bore hole, and made the water foul, the hole was stopped with bags of clay, and no further use had been made of it than as a sump well to contain the pumps. The accident was accounted for in this way:—In driving the pipe, great resistance was offered by the "hugging" of the plastic clay, and cousiderable percussive force had to be used. In cousequence several of the screws which held the joints were shaken out, and the pipe having been improperly driveu through the layer of gravel, sand, and stones, into the sand beneath, there was an escape of water through the screw-holes, and sand followed in sufficient quantity to cause inconvenience.

The steam-engine worked one double-acting pump for supplying the fountains, and two other pumps for raising water from the springs into the tanks above the building. At an average speed of sixteen strokes per minute, the first could throw 660 gallons, aud the other two together 600 gallons per minute. This engine is the one now mainly used. The supply of water from the springs was still found to be abundant. The pumping of six hundred gallons per minute lowered the water from 20 feet to 24 feet, when it remained stationary as long as the eugiue was kept working. The level of the water did not appear to be gradually lowering, and it was stated that on December 1st, 1858, it rose to within 66 feet of T. H. W. M., being about the same level as it stood in December, 1847. The author thought there could be no doubt that the greater portion of the water was obtaiued from the chalk.

He then referred to the fact of the towns of Brighton, Croydon, Deal, Epsom, Ramsgate, and Woolwich, being all supplied with water from the chalk formation. There was an uncertainty, however, of obtaining a good supply from the chalk, as was illustrated in the case of the well sunk at Messrs. Truman's brewery. In 1857, a greater supply of water heing required by the Messrs. Trumau, it was determined to extend the works. In the first place, the sand aud water above the chalk were shut out, then the well was continued to a depth of 300 feet from the top, when it was discontinued, as no water came up the well-hole. As the chalk showed indications of water at the depth of 285 feet, the floor of the tunnels was commenced at that level. These tunnels were 5 feet 6 inches high by 4 feet wide; that on the north side was driven to a length of 7 feet, and that on the south side to 48 feet. The quantity of water now obtained did not exceed twelve and a half gallons per minute. The water of the springs in the sand had been taken by tapping the cylinders, at the bottom, instead of, as hitherto, near the top of the sand stratum.

A well sunk at Messrs. Combe's brewery, to a depth of about 48 feet into the chalk, produced a supply of 70 gallons per minute. The water stood 20 feet higher in this well than in the Trafalgar-square well, while the water in both wells was in a state of rest.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Quarterly Meeting, October 18th. 1859.

WM. FAIRBAIRN, Esq., F.R.S., &c., President, in the Chair.

The PRESIDENT announced the formation of a Mathematical and Physical Section in connection with the Society.

Dr. F. CRACE CALVERT presented, in the name of Mr. Arnandon (from Turin), a paper and samples of green colours used in painting and printing, and especially referred to two new chrome greens, one of which is a new compound, corresponding to the monohydrate of Sesquioxyde of chrome $Cr^2 O^3 HO$.

The author commences in his work to point out the qualities which a good green ought to possess, in order to be suitable for painting. Then he reviews in a few words the different greens which are found at present in the market, together with the nature and properties of the same. Beginning with the history of the works already published on this subject, he next gives the description of his process for preparing his monohydrate of sesquioxyde of chrome, and which consists in exposing the bichromate of potash mixed with phosphoric acid and any deoxydising agent (for example, ammonia) for some time to the action of heat. The soluble salts are then removed by washing.

The green so prepared has not only a beautiful shade, but, like that of Mr. Guignet (made by decomposing the borate of oxyde of chrome by water), possesses the curious property of remaining green under the influence of artificial light.

Dr. CALVERT also presented some muslins printed by M. Camille Kæchlin, of Mulhouse, with Fuchsine, a product obtained from the Aniline of coal tar. This colour was very remarkable, from the exquisite bloom of the pink shade obtained when fixed with albumen.

The following extract of a letter received from Professor W. Thomson, F.R.S., honorary member of the society, &c., was read by Dr. JOULE :—

"I have a very simple 'domestic' apparatus, by which I can observe atmospheric electricity in an easy way. It consists merely of an insulated can of water to set on a table or window-sill *inside*, and discharge by a small pipe through a fine nozzle two or three feet from the wall. With only about ten inches head of water, and a discharge so slow as to give no trouble in replenishing the can with water, the atmospheric effect is collected so quickly that any difference of potentials between the insulated conductor and the air at the place where the stream from the nozzle breaks into drops, is done away with in my apparatus at the rate of five per cent. per half second, or even faster. Hence a very moderate degree of insulation is sensibly as good as perfect, so far as observing the atmospheric effect is concerned. It is easy, by my plan of drying the atmospheric round the insulating stems, by means of pumice stone moistened with sulphuric acid, to insure a degree of insulation in all weathers, by which not more than five per cent. per minute will be lost by it from the atmospheric apparatus at any time. A little attention to keep the outer part of the conductor clear of spider lines is necessary. The apparatus I employed at Invercloy stood on a table, beside a window, on the second floor, which was kept open about an inch, to let the discharging tube project out without coming in contact with the frame. The nozzle was only about two feet and a half from the wall, and nearly on a level with the window-sill. The divided ring electrometer stood on the table beside it, and acted in a very satisfactory way (as I had supplied it with a Leyden phial, consisting of a common thin white glass shade, which insulated remarkably well, instead of the German glass jar—the second of the kind which I had tried, and which would not hold its charge for half a day).

"I found from $13\frac{1}{4}°$ to $14°$ of torsion required to bring the index to zero, when urged aside by the electromotive force of ten zinc-copper water cells. The Leyden phial held so well, that the sensibility of the electrometer measured in that way did not fall more than from $13\frac{1}{2}°$ to $13\frac{1}{4}°$ in three days.

"The atmospheric effect ranged from 30° to above 420° during the four days which I had to test it—that is to say, the electromotive force per foot of air, measured horizontally from the side of the house, was from 9 to 126 zinc-copper water cells. The weather was almost perfectly settled, either calm, or with slight east wind, and in general an easterly haze in the air. The electrometer, twice within half-an-hour, went above 420°, there being at the time a fresh temporory breeze from the east. What I had previously observed regarding the effect of east wind was amply confirmed. Invariably the electrometer showed very high positive in fine weather, before and during east wind. It generally rose very much, shortly before a slight puff of wind from that quarter, and continued high till the breeze would begin to abate. I never once observed the electrometer going up unusually high during fair weather without east wind following immediately. One evening in August I did not perceive the east wind at all, when warned by the electrometer to expect it; but I took the precaution of bringing my boat up to a safe part of the beach, and immediately found, by waves coming in, that the east wind must be blowing a short distance out at sea although it did not get so far as the shore.

"I made a slight commencement of the *electro-geodesy* which I pointed out as desirable at the British Association, and in the course of two days, namely, October 3rd and 4th, got some very decided results. Macfarlane, and one of my former laboratory and *Agamemnon* assistants, Russel, came down to Arran for the purpose. Mr. Russel and I went up Goatfell on the 3rd instant, with the portable electrometer, and made observations, while Mr. Macfarlane remained at Invercloy, constantly observing and recording the indications of the house electrometer. On the 4th instant the same process was continued to observe simultaneously at the house and at one or other of several stations on the way up Goatfell. I have not yet reduced all the observations, but I see enough to eave no doubt whatever but that cloudless masses of air, at no great distance from the earth—certainly not more than a mile or two—influence the electrometer largely by electricity which they carry. This I conclude, because I find no constancy in the relation between the simultaneous electrometric indications at the different stations. Between the house and the nearest station the relativ variation was least. Between the house and a station about half-way up Goatfell, at a distance estimated at two miles and a half in a right line, the number expressing the ratio varied from about 113 to 360 in the course of about three hours. On two different mornings the ratio of house to a station about sixty yards distant, on the roadside beside the sea, was 97 and 96 respectively. On the afternoon of the 4th instant, during a fresh temporary breeze of east wind, blowing up a little spray as far as the road station, most of which would fall short of the house, the ratio was 108 in favour of the house electrometer—both standing at the time very high—the house about 350°. I have no doubt but that this was owing to the negative electricity carried by the spray from the sea, which would diminish relatively the indications of the road electrometer."

ON IRREGULARITIES IN THE WINTER TEMPERATURE OF THE BRITISH ISLANDS.

BY MR. HOPKINS.

This paper was a continuation of one previously read to the society, in which it was maintained that the superior warmth of the British Islands in the winter is due to the large amount of vapour that is then condensed over them. To this proposition an objection has been taken, that the degree of warmth experienced in the locality is not always proportioned to the condensation of vapour as indicated by the fall of rain. This was admitted, but it was contended that the objection taken did not invalidate the general proposition. It was then shown that when vapour was condensed in abundance, and the local atmosphere thereby much heated and expanded, the adjoining heavier air forced the lighter to ascend to upper regions, conveying the liberated heat of the condensation with it to warm those regions, and, of course, leaving the lower air unheated. But in the winter, when the vapour was supplied from the ocean in more moderate quantities, at the time that the surface of the earth was cold, the vapour was condensed by that cold, and gave out the heat of elasticity near the surface. In this way it was shewn that ice was often formed on very cold ground, and mist and fog produced, at moderate heights, over land not so cold, leaving the liberated heat of vapour to warm the lower regions. And this warmth remains near the surface when the condensation takes place, during thick fogs and light drizzling rains, because there is not sufficient heat set free to produce an ascending aerial current. The western coasts of Ireland and Scotland, in the winter, are in this way enveloped in a warm mist, a thick fog, or a small drizzling rain, which gives out a considerable amount of heat that remains in the lower regions, thus raising their temperature. The same processes take place over England, and the whole of the western coast of continental Europe, making them misty and warm in proportion to the extent to which vapour is condensed over them, as compared with parts farther east in the same latitudes. Instances were quoted of this kind of heating in northern mountainous countries.

In the course of the discussion which followed the reading of the paper, the Rev. W. N. MOLESWORTH supported the hypothesis, that the favourable climate enjoyed by Great Britain was, in a great measure, owing to the influence of the Gulf Stream. He believed, also, that a current existed in the Pacific Ocean, near the western coast of North America, by which a warm stream was carried from the tropics to higher lattitudes, thus raising the annual temperature of Vancouver and Queen Charlotte's Islands, and the neighbouring coasts.

Mr. HOPKINS, in reply, remarked that the existence of the latter oceanic current had not been established by any satisfactory proofs.

Ordinary Meeting, November 1st, 1859.

J. P. JOULE, LL.D., F.R.S., Vice-President, in the Chair.

ATTENTION was drawn to the extreme depression of the barometer, which had occurred during the day. About noon, in Manchester, the mercury stood at 28·4 inches. At Belfield, near Rochdale, Dr. Schunck observed an atmospheric pressure of only 28·12 at nine o'clock, a.m.

The CHAIRMAN stated that he had received a letter from Professor Thomson, explaining that, although he had mentioned five per cent. of loss per minute as a perfection of insulation easily attained in his apparatus, he found that by carefully selecting the glass stems, and having the atmosphere in which they are placed, well dried by sulphuric acid, the loss by imperfect insulation of the testing conductor might readily be diminished to five per cent. per hour. He had found also that the Leyden phial, to the inside coating of which the index was connected, did not lose as much as one per cent. per day, even when the instrument was exposed to sea spray in a boat, to rain, and to fog, besides experiencing great changes of temperature.

N.B.—The observations recorded in the last number of the proceedings, as having been made on the 3rd and 4th of October, were made on the 10th and 11th of that month.

EXPERIMENTS ON THE STRENGTH OF CAST IRON GIRDERS.

BY JAMES G. LYNDE, M. INST. C.E., F.G.S.

THE paper was accompanied by a diagram, shewing the arrangement of the apparatus made use of in the experiments and the dimensions of the beams referred to.

The beams experimented on were 89 in number, and were cast by Mr. Mabon, at the Ardwick Iron Works, Manchester, from iron of the following descriptions:—

One charge of the cupola consisted of
12 cwt. Goldendale, Staffordshire.
12 „ Lane End, „
12 „ Ormsby, Yorkshire.
12 „ Blair, Scotch.
12 „ Calder, „
All No. 3 hot blast iron.
12 „ scrap.

The beams were cast on their sides, aud were a very good sample of workmanship.

The section of each beam was of the form recommended by Professor Hodgkinson, and upon which his formulæ were based; the total depth of the beam in the centre was $24\frac{1}{4}$ inches, and at the ends 20 inches; the bottom flange was 15 inches wide, and $2\frac{1}{4}$ inches thick; the vertical part of the beam was $1\frac{1}{2}$ inch thick; and the top flange was $4\frac{1}{2}$ inches wide, and $1\frac{1}{2}$ inch thick; the total length of the beam was 34 feet 6 inches, and the distance between the supports was 30 feet 9 inches; the weight of the beam was 3 tons 8 cwt. 1 qr.

One of the beams was tested up to the breaking weight with the following results:—

	Tons.	Cwt.		Inch.
With a load in the centre of	31	8	the deflection was	·87.
„ „	42	16	„	2·00.
„ „	46	12	„	2·25.
„ „	50	8	„	2·56.
„ „	54	4	„	2·70.
„ „	58	0	the beam broke,	

the ends springing back from each other 2 feet 3 inches, the fracture indicating a good sound casting.

There was no permanent set observable in any of the experiments, until the breaking weight was applied, the beam being allowed to recover itself on the removal of the load in each case.

Each of the remaining beams was tested with a load of 20 tons in the centre, the deflection varying from $\frac{5}{8}$ths to $\frac{7}{8}$ths of an inch.

The calculations for the strength were based on the following formulæ, given by Professor Hodgkinson in his "Experimental Researches on the Strength and Properties of Cast Iron:"—

First formula, art. 146:

Let W= the breaking weight in tons placed on the centre of the beam,
a = the area of the bottom flange in inches,
d = the total depth of the beam in inches,
l = the length between the supports in feet,

then $W = \frac{2 \cdot 166\ a\ d}{l}$

In this case

$$a = 36,\quad d = 94 \cdot 25,\quad l = 30 \cdot 75,$$

which gives 60·09 tons as the breaking weight of the beam.

The second formula, art. 147, takes into account the thickness of the vertical part of the beam, and is as follows:—

Let W = the breaking weight in tons placed on the centre of the beam,
l = the length between the supports in feet,
b = the breadth of the bottom flange in inches,
b' = the thickness of the vertical part in inches,
d = the whole depth in inches,
d' = the depth from the top of the beam to the upper side of the bottom flange in inches,

then $W = \frac{2}{3\ d\ l}\left(b\ d^3 - (b\ d')d'^3\right)$

In this case

$$l = 30 \cdot 75,\quad b = 15,\quad b' = 1 \cdot 5,\quad d = 24 \cdot 25,\quad d' = 22 \cdot 03,$$

which gives 62·19 tons as the breaking weight of the beam.

The actual breaking weight being 58 tons, it would appear that the constant coefficient assumed is, in each instance, too high for the quality of iron of which these beams were cast. The result appears to have been anticipated by Professor Hodgkinson in the case of large beams; and in one of his experiments, art. 147, on a beam cast for Messrs. Marshall and Co., of Leeds, he gives ·625 as the coefficient, which agrees with the result of this experiment.

Applying this coefficient to Professor Hodgkinson's formulæ, they will be as follows:—

First Formula, $W = \frac{2 \cdot 05\ a\ d}{l}$

Second formula, $W = \frac{\cdot 625}{d\ l}\left(bd^3 - (b - d')d'^3\right)$

The first of these would give 58.2 tons, and the second 58·31 tons, as the breaking weight; either of which calculations would be sufficiently correct for auy practical purpose.

Ordinary Meeting, October 4th, 1859.

WM. FAIRBAIRN, Esq. F.R.S., &c., President, in the Chair.

RESEARCHES ON SEVERAL ORGANIC COLOURING MATTERS.

By DR. F. CRACE CALVERT.

THE most remarkable of these researches is one concerning nine different species of wood, termed by the author, collectively, *bois d'amarante* (and one of which is known in Englaud under the name of the purple heart), on account of their containing a peculiar colourless principle capable of being transformed into a substance of fine purple colour by the action of light, heat, and acids. Oxygen is unnecessary to this transformation, as it takes place equally in an atmosphere of hydrogen or in vacuo. A solution of the colourless principle exposed to the action of the air during several years, in a dark place, remained perfectly unaltered.

The purple colouring matter differs entirely from the colourless principle from which it is obtained, not only by its colour, but also by other physico-chemical properties; thus, for instance, it is less soluble in water, and in ether, more volatile, and contains a greater proportion of carbon, than the colourless principle. It may be reduced in the same manner as indigo blue.

Amongst the many interesting experiments which may be performed with this colouring matter, and of which several were repeated during the evening, we may mention the following. A quantity of the colourless soloution is introduced into a glass tube, from which the air is then expelled, and the tube hermetically closed. If the tube be now exposed to the direct rays of the sun, the solution assumes a purple colour, and red flakes of colouring matter are deposited. When acidulated with hydrochloric acid, the colourless solution acquires a purple hue when heated up to 80° C. If the colourless principle in the dry state be enclosed iu a tube containing hydrogen, or devoid of air, and exposed to a temperature of 160° C., in the dark, the purple colour is at once produced.

The wood and its decoction show the same phenomena, but with less intensity. Woollen, silk, and cotton stuff, with or without mordant, steeped in this decoction have only a brown or greyish hue, as long as the orignal substance has not been modified. But when so prepared, they are exposed to the action of light or heat, or immersed in a bath of acidulated water, they are at once dyed of a purple hue.

The colour thus produced withstands perfectly the action of acids, it is rendered slightly more blue by alkalis, and resists light better thau archil purples and aniline.

A second research is on the Bois de Taigu, from Paraguay (or *Ebene soufré*), from which the author has separated an acid principle, which crystallizes in beautiful yellow prisms, and yields crystallizable salts of a scarlet colour.

Then follows a notice on the Quebracho wood of South America, from which Mr. Arnaudon has produced a fine yellow on wool.

Violet Palisander wood (Madagascar), contains a violet colouring matter which differs from that of the bois d'amarante, and may be fixed in the same manner as the colouriug matter of logwood.

In a last notice on the colouration of the solontion of guaiac resin, the author shows by experiments that it is produced only by the action of oxygen.

From general considerations deducted from comparative experiments set down by him in tabular form, M. Arnaudon concludes that, with our present chemical knowledge, general laws for the production of organic colouring matters cannot be laid down.

ON THE CAUSE OF COLOUR AND THE THEORY OF LIGHT.

By MR. JOHN SMITH, M.A.

THE author, in attempting to explain certain natural phenomena, could not satisfy himself by applying the principles of either theory of light, and said that many natural phenomena indicated beats or vibrations in the luminous ether very different from what science taught. That is, that there were greater iutervals between them than Newton had demonstrated, and scientific men believed. He therefore endeavoured to contrive experiments by which he would be able to make as many revolutions or beats in a second as he considered the effective vibrations of light were repeated in a second of time, and argued that by certain contrivances to produce light and shade in alternate vibrations he should produce colour. A series of experiments was subsequently undertaken, which led to the conclusion that varieties of colour are produced by pulsations of light and intervals of shadow in definite proportions for each shade of colour. That is, supposing white light to consist of the motion of an ether, blackness to consist of an entire absence of motion, then a certain colour, blue, red, or yellow, will be produced by the alternate action of the light and the shadow. The author used shadow in the positive sense as the sensation was positive.

On pursuing the enquiry, he first caused a small parallelogram cut in card board to revolve over a black surface with a rapidity which he considered equal to the vibration of light, by this motiou he obtained a distinct blue, while at another time in different weather he obtained a purple. He then made a disc with several concentric rings, which he painted respectively $\frac{1}{3}$, $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{1}{2}$ black leaving the remainder white; and on making this disc revolve the rings became completely coloured. There was no appearance of any black or white. In a bright day with white clouds in the sky the rings were coloured respectively a light yellowish green, two different shades of purple, and a pink. By using discs of a great variety of shapes and different proportions of white aud black, the author said that he produced successively or together all the colours of the rainbow, although he had not yet arrived at the exact arithmetical determination of the amount of light and shade needful for each.

These experiments were made before the Society by the light of a paraffin oil lamp with a reflector. The author said they were much more brilliant by sunlight.

There was another set of experiments which the author considered very effective, and especially as being easily made and described, but requiring strong sunshine to show them. These were made by casting a shadow of a particular figure on a white wall or on a sheet of paper, so as to produce alternate beats of light and shadow when put in revolution. The figure became coloured of different shades, and because these could be seen on the wall, like the spectrum from the prism, he called them spectra by reflection.

He mentioned also that the colours may be produced by making a black disc, with figures cut out of it, revolve before a white cloud or white screen.

There were many others which he had no time to enumerate, much less to describe, but he described some of the figures which produce the phenomena which are perceived when looking through transparent solids.

The author considered that his theory gave an entirely new and simple explanation of the phenomena of refraction through the prism, and summed up as follows:—

The experiments prove the homogeneity of the ether.

They prove the undulatory hypothesis, but oppose the undulatory theory.

They enable us to dispense with the different refrangibilities of the rays of light, as taught by Newton.

They help to explain many of the phenomena of what is called the polarization of light.

They give a new explanation of prismatic refraction, and explain in a plain and simple manner many very interesting natural phenomena.

Startling, he said, as these conclusions are to those who are conversant with the subject of light, he thought he was perfectly warranted in drawing them from his experiments. The general process of reasoning could not, however, be given in a short abstract.

CORRESPONDENCE.

We do not hold ourselves responsible for the opinions of our Correspondents.

STEAMSHIP ECONOMY.

To the Editor of the Artizan.

Sir, In the various criticisms of my pamphlet by your numerous contemporaries, not one of them has ventured to prove that perfection in steamships is unattainable; nor the ascertaining the maximum mechanical (useful) effect of steam, is a proposition unworthy the consideration of the scientific world.

As the proposed question of my pamphlet is not so clearly defined as I would wish, I will avail myself of the valuable experiments of the *Fairy*, published in the November number of the Artizan, to exhibit the application of my theory to steam navigation, as they afford me a complete confirmation of my definition of the power of the steam engine.

To render my theory as simple as possible, I affirm: Frst, that with a given pressure of steam on the ends of the cylinder, and a minimum velocity of piston to be determined, (say 3 feet,) a certain amount of mechanical effect, or velocity of steam vessel is obtained, which, I assert, cannot be increased by adding to the velocity of the piston, the pressure on the ends of the cylinders, remaining constant. Second, that if an increase of mechanical effect or speed of steam vessel is required; the indispensible condition is to increase the pressure on the ends of the cylinder, and: Third, that the best proof of the correctness of these principles, is produced by the generally accepted formnla $\frac{V^3 \times \text{Mid. Sec.}}{\text{ind. H. P.}} = C$; or Mr. Atherton's $\frac{V^3 \times D^{\frac{2}{3}}}{\text{ind. H. P.}} = C$; by the coefficients varying in the proportion of the velocity of the piston.

The following data are the six first, and two last experiments of the *Fairy*, published in your previous number.

As a little misconception exists with respect to the column "Deduced Speed," I hope the following explanation will be sufficient to explain its meaning.

Many of your readers are aware, that I have defined a limit to the mechanical effect of force, the quantity being one foot lb.. by a one pound pressure of steam, in one second of time. Is this quantity too great, or too small, is the simple question asked in my pamphlet? Assuming that quantity to be correct; then when a machine, say a steam vessel, has produced that amount, the vessel is perfection, and no improvement can be made in the form of ship, or propeller. This quantity is embodied in the formula $V^2 = \frac{\text{Force}}{\text{Mid. Sec.}}$ consequently if the actual speed of the vessel equals the deduced speed, the combined vessel and propeller is perfection. Thus in the *Fairy* none of the experiments are perfection, the actual speed varying between 87 and 83 per cent. (ratio of speed) of the deduced speed. Although I have not the slightest doubt the pressure of steam in the cylinders is performing an equal amount of foot pounds; it is not producing it in the direction required; thus the "ratio of forces," shows the amount utilized; or it may said to be equivalent to the coefficient produced by the formula $\frac{V^3 \times \text{Mid. Sec.}}{\text{Ind. H. P.}} = C$ without the velocity of piston introduced; or, $V^3 \times$ Mid. Section = pressure in cylinders × coefficient, or ratio of force..

As I have stated, the best proof of my views, is produced by the formula $\frac{V^3 \times \text{Mid. Sec.}}{\text{Ind. H. P.}} = C$, I have tabulated the experiments of the *Fairy* according to these coefficients commencing with the highest; thus in the coefficient 579, the velocity of piston is 3·12, and when 4·42, the coefficient is 412, or exactly in the proportion of the velocity of the piston. These are not solitary experiments in favour of my theory, but it is abundantly confirmed by the data supplied by the steam department of the Admiralty, published in the Artizan in the previous March number.

Let me now invite attention to the experiments of the "*Fairy*," and it will be found that 50,593 lbs. with a velocity of piston of 3·12 feet per second, has propelled the vessel 12·49 knots per hour; by a further perusal of the data, it will be found that by diminishing the pitch of the screw from 10 to 7 feet, the Indicated H. P. of the engines has increased from 287 to 403 Ind. H. P., or what the universal practice of engineers calls the power of the steam engine. Has the speed of the vessel increased in proportion to that increase of power? Experiment says no, but points out that the average pressure in the cylinders, and speed of vessel, are the same in both trials, the same uniformly in the pressure existing in the first six trials.

Let me now invite the attention of the Committee of the British Association for the investigation of steam ship performance to the coefficients in the data, and to the tabulated data in my pamphlet, page 85, 86, and 87 in connection with the column velocity of piston, when I think reasons will be discovered for a reconsideration of the rule of Indicated Horse Power.

One more perusal of the experiments of the *Fairy* is required to show that after numerous propellers have been employed to increase the speed of the vessel, they have been unavailing, until the pressure in the cylinders has been increased as will be seen by the latter experiments of that vessel. Let me here point out that the coefficients by the Admiralty formula vary from 412 to 579, or a variation of 40 per cent.; while my coefficients without the velocity of the piston (ratio of forces), only vary from 68 to 79 or 16 per cent. in the trials of the *Fairy*.

Allow me space to point out to your readers, the difference between my system of analysis, and that adopted by Admiral Moorsom in the Trials of the *Ermina*. For the sake of argument I will admit that the "absorbed power" &c., of the *Ermina* is correct, as stated in the Memorandum in the November number of the Artizan, and likewise bears the same proportion in all other vessels. We will then have in the first trial of the *Ermina* a pressure of 11,461lbs. pressure through 2·62 feet per second, producing an equivalent to the absorbed power, &c., and a velocity of six knots.

Now in my mode of investigation, I assume that the above pressure, and velocity of piston, after producing that equivalent; (effect not utilized in the pro-

	Speed in Knots.	Speed in feet per second.	Mid Section.	Average pressure in Cylinders.	Vel. of Piston in feet per second.	Ind. H. P.	Deduced Speed.	Ratio of Speeds.	Ratio of Forces.	$\frac{V^3 \times \text{Mid. Sec.}}{\text{Ind. H. P.}}$	Pitch of Screw.		Resistance to Mid. Section.
											Ft.	In.	
Fairy	12·49	21·10	85	50,593	3·12	287	24·39	·86	·73	579	10	0	1793
Do.	12·12	20·48	85	51,472	3·60	337	24·59	·83	·68	461	6	0	1740
Do.	12·09	20·43	85	49,286	3·85	345	24·06	·85	·72	450	7	11	1746
Do.	12·35	20·87	85	50,000	3·95	356	24·24	·86	·73	445	8	0	1774
Do.	12·04	20·34	85	50,540	3·70	340	24·39	·83	·68	432	8	0	1729
Do.	12·55	21·22	85	50,147	4·42	403	24·28	·87	·75	412	7	0	1805
Do.	13·17	22·34	87	55,412	4·00	403	25·23	·89	·79	492	8	6	1943
Do.	13·21	22·32	87	55,885	4·35	442	25·33	·88	·77	452	8	0	1941
Ermina	6·00	10·14	149	11,461	2·62	54·6	8·77	1·15	1·32	591	13	0	1510
Do.	6·83	11·54	149	16,023	3·00	87·4	10·34	1·11	1·23	542	13	0	1719
Do.	7·98	13·48	149	16,553	4·05	122	10·53	1·28	1·63	620	13	0	2008

pulsion of the vessel;) can only produce 11,461 foot lbs. of *useful* mechanical effect, or the resistance in the last column (= area × velocity feet per second) through 10·14 feet in that time. Or it may be thus expressed: after allowing for friction, absorbed power, &c., it has been found by experiment that a force of 100, 121, 144, & 400lbs. for each square foot of midship section in a well defined and known form can produce a velocity of 10, 11, 12 and 20 feet per second, therefore the result of the first trial of the *Ermina*, may be thus stated; with the above quantities of force to midship section the speed of the vessel is 15 per cent. greater than the "deduced speed"—the speed of the well known form with a force of 11,461lbs. on the ends of the cylinder, or that this quantity of pressure with the form of the *Ermina* has produced the same speed as 15,000lbs., would produce in the well known form, to which Colonel Beaufoy's formula is applicable, and is in accordance with his system of investigation.

The two trials of the *Orlando* are amply sufficient to show that the theory of our great marine engineers "is generally determined by the sort of experience, popularly called the rule of thumb," but in the instance of the above vessel, that rule does not hold good, as the speed of the vessel was diminished one half knot per hour, after what was considered an improvement in the proportions of the propeller a reduction in the pitch of the screw. These experiments are a complete verification of Admiral Moorsom's practical experience on this subject, as well as the truth of the candid admission of an individual who has constituted himself the master and teacher of the science of Naval Architecture "and who never fails to express his disregard for the opinions and talents of others," in language uot altogether courteous.

The admisssion is as follows. "And now we are about to enter upon what promises to be a larger, and more costly reconstructiou of the Navy. than that through which we have passed, and we enter upon it as completely ignorant of the best dimensions and form of ship for securing speed and steadiuess as we were ten years ago,"

The reply to the important question asked by Admiral Moorsom will give me an opportunity of showing the results of my theory with the actual performances of the vessels. "Does the speed of the *Orlando*, being about 13½ knots, with 420 Ind. H. P., answer to the deductions of science, when compared with the *Rattler* with a speed of about 9½ knots, with 436 Ind. H. P.?" For the former vessel, according to my theory, the force would be 497lbs., while the actual average pressure in the cylinders is 432lbs. for each square foot of midship section, and in the *Rattler* 348lbs., to 289lbs., or exactly in the same proportion as in the *Orlando*. In the former vessel the velocity of piston is 3·46 feet per second, and in the latter 7 feet, now if the pitch of the screw of the *Orlando* is increased to 40 feet in the next trial, the speed of the vessel would be 14 knots with a diminished velocity of piston. It is to this point that I invite the atteution of the Committee of the British Association for the investigation of steamship performance. What is the minimum velocity of piston for any rate of speed? If the sort of experience popularly called the rule of thumb is adopted, it will be found that the *Fairy* has a velocity of piston of 4 feet per second for 13¾ knots, the *Anglia*, *Cambria*, and *Scotia* for the same speed, a velocity of piston under 4 feet; the *Simla*, the same speed with only 3·72 feet velocity of piston, and the trials of the *Algiers*, *Miranda*, *Desperate*, *Canada*, *Pera*, &c., &c., are all pointing in the direction, that a velocity of piston above 3 feet per second, is an absolute waste of fuel, and wear and tear of machinery. A reconsideration of the rule of indicated horse power, I venture to submit, ought to be the first investigation of the Committee of the British Association, aud the various mechanical institutions of this country.

ROBERT ARMSTRONG,
Naval Architect.

THE GREAT EASTERN.

To the Editor of The Artizan.

Sir,—"*Palmam Qui Meruit Ferat*," in a letter addressed to you in the November number of the Artizan, claims for a Mr. W. Radford, R.U., the creditof having propounded the first idea of this great ship.

Having recently carefully and attentively perused Mr. Radford's little work, I am satisfied that he had given great and attentive consideratiou to the subject of ocean steam navigation by large ships, and that his matured views and published ideas on the subject led to the construction of the Great Eastern. That this is the fact, any one reading his little work will be fully convinced, as the language of Mr. Radford and that of the prospectus alluded to, curiously coincide.

My object in writing this letter is to put on record the claim of another gentleman, a Mr. Holmes, an engineer, who some years before Mr. Radford came before the public, had in 1838, proposed a line of large steamers to ply between England and Calcutta.

These vessels were classified by him, and were to be built of iron, and to be of 2618 tons burthen, and 600 horse power. Their extreme length 300 feet, beam, 45 feet, depth of hold, 30 feet. The length of the principle saloon, 128 feet. There were 16 private cabins, and 400 berths for passengers. Their draught of water was to be 15 feet; and their cylinders 84 inches in diameter, and 9 feet stroke.

Mr. Holmes calculated that they would make the voyage to Calcutta frmo Falmouth in about thirty days. When he first broached the subje.t to the Admiralty and elsewhere, the idea was laughed at, and he was begged to desist from so futile a plan.

These particulars are extracted from a little volume entitled "The Wonders of Nature and Art," published at Halifax, Yorkshire, in 1839, by William Milner.

I think this and the letter in last month's Artizan satisfactorily show, that the Great Eastern did not emanate at the time, and from the source popularly believed.

Possibly others of your readers may have further information and facts bearing on this subject which may be interesting, and should be put on record, as adding to the general information on such interesting subjects, and I trust if there are such, they will take an example from "*Palmam, &c.*"

I am, Sir,
Your obedient servant,
NAUTICUS.

Portsmouth, Nov. 16th, 1859.

UNSINKABLE SHIPS.

To the Editor of The Artizan.

Sir,—As modern improvements in ordnance threateu to render extensive modifications in the construction of ships absolutely necessary, the idea occurred to me that the priuciple of constructing vessels in such mauner and with such materials as to be unsinkable, however, perforated by shot, may be worthy of consideration; and as the discovery of material suitable for the practical carrying out of this principle appeared to me to be a matter peculiarly withiu the province of the Society of Arts, I addressed a letter to the *Society of Arts Journal*, of which I beg to inclose a copy, in the hope that you will give this subject publicity in the Artizan.

It is gratifying to me to be enabled to inform you, that I have already received communications from different parties, to the effect that the idea thus suggested by me is practicable, so far as the production of material possessing the properties referred to is concerned. Should the Council of the Society of Arts be disposed and enabled to take up this subject in the manner proposed, I have no doubt that a material of light specific gravity, suitable uot only for the construction of unsinkable ships, but also adapted for improvement in life boats aud other useful maritime purposes, will be forthwith brought before the notice of the public.

I am, Sir,
Yours very obedient,
CHARLES ATHERTON.

Woolwich Dockyard, 21*st Nov.*, 1859.

Sir,—Modern ordnance has now necessitated reformation in naval construction as a matter of such importance, that I presume good service may be rendered to public interest by renewing, simultaneously, attention to the following communications which appeared iu the *Times* of the 12th Jannary last and 7th October inst.;—

(*Times*, 12th Jan., 1859.)

"To the Editor of the Times.

"Sir,—Mauy suggestions have of late been brought before the public on the construction of gun-boats, mortar-boats, and floating batteries, with a view to make them invulnerable; and I now beg to add my views on the subject. Why not make the floating body for such special services, up to the line of its load displacement, a solid mass of material, of such specific gravity lighter than water that it shall not sink, however much it may be perforated by shot? It appears to me that a solid combination might be made of cork shavings, light wood sawdust, rush stems, cotton waste, flocks, hemp, and other light material, which, by the aid of a solution of gutta percha, or other chemical process, would form a solidifying mass, so tough that it could not be knocked to pieces by shot, and so light that it would be only one-half the specific gravity of water, and therefore unsinkable, however perforated by shot, and capable of carrying armament and naval equipment to the extent of nearly one-half the weight of its own displacement in tons. Such vessels of light draught accompanying fleets of war as tenders to line-of-battle ships, whence they might be manned and stored as occasion might require, would, I submit, form a suitable auxiliary available for shore service, or for attacking land batteries, which deep draught ships of the line cannot approach, and would be sunk if they could.

"I may observe that this idea was first broached by me two years since, as beiug applicable to the construction of vessels carryiug treasure. They might be wrecked ashore, but the treasure would be recoverable.

"I am, Sir,
"Your very obedient servant,
"Charles Atherton.

"Woolwich Dockyard,
"Jau. 10, 1859."

(*Times*, 7th Oct., 1859.)

"Naval and Military Intelligence.

"Since the *Trusty*, 14, steam floating battery, returned to her fomer mooriugs opposite Upnor Castle, Chatham, she has undergone an examination in order to ascertain the amount of injuries she had met with during the experiments that were made on her, with the view of testing her capabilities of resisting the effects of the shot fired from the Armstrong cannons at Shoeburyness. The result of the survey has demonstrated that this new kind of iron-cased floating batteries presents comparatively no resistance whatever to the shots of the Armstrong guns. Although the *Trusty* is covered with massive iron plates, of extraordinary thickness, yet every shot that struck them shivered the plates to pieces, and entered the vessel; some of the shots, it is evident from the examination, having passed through the iron plates and beams of the battery on one side. and through the timber and iron casing of the vessel on the other. The battery presents the appearance of having been most severely handled; and it is the unauimous opinion of the officers and others who have examined her, that vessels of this class will be almost entirely useless when fired upon by guns of the Armstrong class."

It having been thus demonstrated that iron-cased ships must go to the bottom under the fire of modern ordnance, and recents event having also shown that ships of the ordinary build may be sunk by the fire even of an ordinary extemporised Chinese fort, the time has arrived when, as it appears to me, the principles of naval construction referred to in my letter published in the *Times* of the 12th January last may be appropriately revived. With a view to promoting this object, I now beg to suggest that if a fund to the exteut of £250 only were publicly subscribed and placed at the disposal of the Council of the Society of Arts, Adelphi, London, to be awarded as preminms of £150 and £100 for the discovery and specification of the materials and process of manufacture most available for producing a solidifying pulp possessing in the highest degree the properties of specific lightness, toughness, non-absorption of water, and cheapness, or a metallic cellular body having the same properties, I have no doubt that, at a moderate cost per tou of shipping, existing vessels may be rendered unsinkable, and that a new modificacion of ships of war of all classes may be devised, such as may obviate the horrors which appear to be otherwise inevitable in maritime warfare under the fire of modern ordnance. Wholesale perdition being thus obviated, the power of nations will again be determined, as heretofore, by the virtues of personal prowess and endurance rather than by chicanery and mechanical device.

"I am, &c., "CHARLES ATHERTON.

"Woolwich Do ckyard, Oct. 11, 1859."

REVIEWS AND NOTICES OF NEW BOOKS.

A Practical Refutation of the English Prejudices regarding the Durability of American-Built Ships and American Timber, Illustrated by a list of American Ships, (Merchant, Men-of-War, and Steam-Ships,) distinguished by their long durability. Prepared by Donald M'Kay, Shipbuilder of Boston, United States. London, Oct. 1859.

"The following Tables," says the Anthor, "were prepared for the purpose of proving by facts, that ships built with carefully selected American timber, viz.: 'Live Oak, White Oak, Pitch Pine,' &c., will last as long as ships built with the best English Oak, in contradiction to the views entertained by Lloyd's Committee, and in support of the favourable opinions cntertained by British merchants in regard to the efficiency and safety of American ships."

The Anthor gives a list of merchant vessels built in America, and with American timber, which have been found, after more than *twenty* years of service, to be in an efficient, seagoing state; and that are yet in actual service in 1859.

This Table is stated to be extracted from the *New York Marine Register*, for 1859, which contains a considerable part of the mercantile marine of the United States, and gives the tonnage of the ships, the timber and fastenings nsed in their construction, the year when, and the State in which they have been bnilt, their present age, remarks on repairs, and the date of the last survey.

RECAPITULATION OF MERCHANT SHIPS.

1. 102 Ships of an average age of .... 24 years.
2. 40 Barks of an average age of .... 25½ years.
3. 54 Brigs of an average age of .... 25 years.
4. 12 Steamers of an average age of.................. 18½ years.

A list of United States men-of-war ships over fifteen years old,* in perfect preservation, aud in an efficient state np to this date, October 1859.

N.B.—The frames of these ships are of live oak, the planking of white oak.

* The term assigned to the average duration of British men-of-war ships, after which they require a *complete* and expensive repair.—(*Statement of the Surveyor of the Navy.*)

RECAPITULATION OF MEN-OF-WAR SHIPS.

1. 9 line of battle ships; average age.................. 38½ years.
2. 5 frigates; average age .... 26 years.
3. 19 sloops of war; average age .... 22 years.
4. 4 brigs; average age .... 20 years.
5. 9 men-of-war steamers; average age.................. 14½ years.

N.B.—All these ships, from the frigates downwards to the brigs, have been, since the time of their launch, iu a continual active service, mostly in hot climates, such as the coast of Africa, the Mediterranean, Brazils, East Indies, China, and West Indies.

These thirty-nine ships form a per ceutage of 85 per cent. of the whole United States fleet of sailing ships.

Cau the English navy present a result more satisfactory than this?

The following Tables on the weight and strength of American ship-timber, &c., will be found useful:—

WEIGHT OF A CUBIC FOOT OF

	Virginia White Oak.		Virginia Yellow Pine.*	
	Round.	Square.	Round.	Square.
After felling..................	64·74lbs.	67·20lbs.	47·81lbs.	39·21lbs.
One year after felling..................	53·60lbs.	53·51lbs.	39·83lbs.	34·16lbs.
Four years after felling..................	45·97lbs.	49·89lbs.	34·28lbs.	33·49lbs.

Each of the above nnmbers are the mean of experiments ou twelve different pieces of timber cut from different trees, and the experiments were made by Mr. Farris, Timber Inspector of Gosport Navy-yard.

* The Virginia Pitch Pine is called in America "Yellow Pine." The Florida Yellow Pine is called the "Long-leaf Yellow Pine," and weighs about 41lbs. per cubic foot.

Weight of a cubic foot of Live Oak, according to Griffith—green, 78·69lbs seasoned, 66·75lbs.

This timber is exclusively nsed for the frames of the United States' Men-of-war ships, and is considered by all naval men to be almost imperishable.

Tensile strength of Amcrican White Oak and English Oak per square inch. (*From Appletons's Dictionary of Mechanics.*) English Oak, 8820lbs. to 10,224lbs. American White Oak, 11,501lbs.

Specific gravity and transverse strength (per square inch) of English Oak, and American White and Live Oak, according to various observers. Extracted from a Table published in Vol. V. of the Professional Papers of the Royal Engineers.

Name of Observer.	English Oak.		American White Oak		American Live Oak.	
	Spec. gr.	Strength.	Spec. gr.	Strength.	Spec. gr.	Strength.
Lieutenant Nelson......	834	1629lb.	645	1699lb.	1160	1862lb.
Mr. Moore	816	1919lb.	836	1699lb.		
Mr. Barlow..............	934	1672lb.	872	1766lb.		
Lieutenant Dennison...	733	1556lb.	772	1809lb.		
Mean results	829	1694lb.	781	1743lb.	1160	1862lb.

According to these experiments, the advantage of lightness, combined with strength, is entirely on the side of American white oak.

Examples of Modern Alphabets, &c. By F. Delamotte. London: E. and F. N. Spon.

The collection of examples is admirable. The book is of a most convenient size, and altogether, it is most creditably got np. Its appearance was most opportune as we can testify, for "Wilme" had been ransacked and exhansted, when thanks to Messrs. Spon, Delamotte came to the rescne. No Engineers, Architect's, Surveyor's, Dranghtsman's, or other office in which ornamental lettering for drawings, plans, &c., has to be execnted, should be without this excellent companion to "the books of ornamental alphabets, &c.," also by Mr. Delamotte, and which latter book was noticed in "The Artizan."

Ure's Dictionary of Arts, Manufactures, and Mines. New edition (chiefly re-written, and greatly enlarged). Edited by Robert Hnut, F.R.S., F.S.S., &c. Loudon: Longman and Co., 1859. Part one.

We hail with considerable satisfaction the publicatiou of a new and mnch improved edition, of a work which has always possesed a considerable amount of popularity, and obtained au enormons sale, and that notwithstanding the previous editions (especially the 3rd and 4th), fell very far short of keeping pace with the gencral advancement made in every branch of the arts and manufactnres, &c., of which it professed to treat

When the 4th edition of *Ure's Dictionary* was pnblished (about the end of 1853), we found, on perusing it, so many errors of omission, as well as commission, so many instances of direct contradiction, the new matter with the old and stereotyped parts, that notwithstanding the greatly increased size and improved appearance of the work, we felt that either new blood should be infused into the compilation, and a division of labour introduced into the collation and treatment of the different classes of subjects, by the employment of yonnger and older men iu each walk of science, or *Ure's Dictionary*, like some other things once thought to be "scientific," would be considered as effete, and have to give place to some other work, on which the various articles or subjects would be treated skilfully, and according to the latest and best authorities. We are therefore glad to find that Messrs. Longman and Co., determined to act in accordance with the views entertained by ns; and they having made an arrangement with Mr. Robert Hunt, to edit the new edition. We have before us part one, consisting of 192 pages of matter, much more in accordance with the present and more advanced state of modern scientific knowledge, most of the articles having been entirely re-written.

Under the talented direction of so illnstrions a devotee of science, as the estimable Robert Hunt, the new edition of *Ure's Dictionary* cannot bnt prove the most modern, reliable, and thorongh exposition of the present condition of arts, manufactnres, and mines, and thus be a most useful text book for the student.

The Life and Times of Samuel Crompton. By Giffard and Freuch. London: Simpkin Marshall and Co.

This very interesting volume ought be universally read, it contains not only the history of Samnel Crompton, and the Spinning Mule; but, we fear also the sad history of many an ingenious and brain toiling benefactor of the human family. Mr. French has done good service to the cause of ingenious and meritorious iuventors, by calling attention to the treatment to which the inventor of the "mule" was subjected.

The book is written in a style which gives additional interest to the vast amount of very interesting circumstances and details which the anthor has collected together most industriously, and arranged most judiciously.

It is only npon persing this work most attentively, that something like a correct idea can be formed if the truly enormous extent to which the invention of the mule by Crompton and its introduction into use in this country alone, had benefited our trade and commerce, and the nncalculable benefits derived from the immense impetus given to industry and civilization throughout the world and the promotion of comfort amongst the operatives and opulence amongst the employers of labour engaged in all branches connected with this descriptiou of industry.

The work is so full of interest to all to whom THE ARTIZAN is addressed, that it would be an injustice alike to the talented author of the book, to the object with which it was published, and to the readers of THE ARTIZAN, were we to set about making extracts, or to cite passages from it; but we say to one and all, *buy it*, it is cheap enough, *read it*, it is most interesting, every page is full of useful information, and the lessons taught by the experience of Crompton, may prove most valuable to some, and perhaps to many of those, who, month by month pore over the pages of THE ARTIZAN.

Stories of Inventors, and Discoverers in Science, and the useful Arts. By John Timbs, F.S.A. London: Kent and Co., Fleet Street.

THE author of this charming collection of interesting historical sketches and anecdotes relating to inventors, and inventions or discoveries, is so well known to the public that it is almost a work of supererogation, to do more than notice the appearance of the work, and state, that in addition to the usual amount of talent having been devoted to it by its author, the book is produced in Messrs. Kent and Co's., best style.

An Inquiry into the Principles of Beauty in Grecian Architecture. By the Earl of Aberdeen, K.T. &c., &c. London: John Weale. 1860.

THIS little volume, forming one of Weale's series of rudimentary works, is merely a republication, in a very cheap form, of that portion of Wilkins' translations of Vitruvius's Civil Architecture, which relates to the principles of beauty in Grecian Architecture, and was written for Wilkins' work by the Earl of Aberdeen. It will, doubtless, prove very acceptable to all architectural students, but particularly to the admirers of Greek architecture.

Dictionnaire de Marine a Vapeur. Par M. le Contre-Amiral. E. Paris (Imp. French Navy.) Paris. Arthur Bertrand. Librairie Maritime et Scientifique. (Rue Hautefeuille, No. 20.) Second Edition. November, 1859.

THIS work is more than a mere technical dictionary, made up of a long string of words with their exact meanings set opposite to them, dictionary fashion,—being a most comprehensive work devoted to a description of every term used in connection with the designing, construction, and employing or working steam or other ships for war or commercial purposes, their engines, boilers, and machinery, and of the tools and apparatus necessary for, and employed in, producing all such works of construction; for not alone does the textual description and explanations of the various terms extend to about 750 pages (imperial quarto) of small type, but thereare added to this, Dictionaries in several languages, by which the various terms used can be rendered or readily be mutually converted from French into English, German, Dutch, Swedish, Russian, Italian, Spanish, &c. And superadded to all this we find some eighteen splendid large folding plates—illustrating every form and description of engine, boiler, screw, or other propeller, &c., and the various parts and details of these machines, &c., &c. Many of the figures, &c., we recognise as originally appearing in this journal. Admiral Paris is the only scientific, and at the same time practical author who has attempted the treatment in French of the marine steam engine and the machinery of steam ships, in the style of John Bourn, and THE ARTIZAN treatise on the steam engine.

To naval officers in the English and other services this work will supply a want sorely felt since the introduction of steam into the navy, and since, also the French and English officers in this branch of the service have been called upon to act together.

To all employed in the construction of marine engines and machinery this work will prove of the greatest possible service.

Report on the Eligibility of Milford Haven for Ocean Steam Ships, and for a Naval Arsenal. By Thomas Page, Civil Engineer. London: Printed by Hansard.

MR. PAGE, the engineer of the new bridge at Westminster, and formerly the acting engineer of the Thames Tunnel, who is much esteemed alike for his professional ability, his courtesy, and his caution, was, it appears by the prefatory remarks in his report, invited by Col. the Hon. R. F. Greville, to survey a part of Milford Haven, in which the gallant Colonel is known to be largely interested, with a view to his giving an opinion on some works which were proposed for the improvement of the steam ship accommodation at present afforded by the town of Milford. But upon Mr. Page visiting Milford Haven for the purpose, he states he was so impressed with the importance of the Haven for national objects, that he suggested that a more general and comprehensive consideration of the subject should be entered upon, and he was thereupon authorized to make a more extended report, andtreat from a national point of view, the capabilities of this, the most magnificent harbour in the world. Accordingly, we have before us an elaborate and admirably drawn report, which contains the largest collection of information extant respecting the extent of dock accommodation, the number and capabilities of building slips, &c, the strength and disposition of the naval arsenals of England and France, and other nations:—of the chiefest interest at the present time, and with which we should be thoroughly acquainted.

Mr. Page enters most fully into the merits of Milford Haven, not only as the site of a great mercantile port, but also for a great depot for the royal navy of England, and fully as he has discussed the advantages of Milford Haven, he has not done more than mere justice to his theme.

We wish every success to the efforts made by Colonel Greville, to giv due m portance to Milford Haven, and we feel bound to compliment Mr. Page most highly upon his able and admirable advocacy of the cause; and we recommend the report to the especial attention of the owners of large ocean going steam and sailing ships, as being worthy of their immediate and serious perusal.

LIST OF NEW BOOKS AND NEW EDITIONS OF BOOKS.

CARTER (T.)—Curiosities of War, and Military Studies, Anecdotal, Descriptive, and Statical. 12mo, pp. 410, 5s. (Groombridge).

LANGE (D. A.)—The Isthmus of Suez Canal Question viewed in its Political Bearing. 8vo, pp. 15, sewed, 6d. (Hatchard.)

RANKINE (W. J. M.)—A Manual of the Steam-Engine, and other Prime Movers. Post 8vo, with numerous Diagrams, pp. 600, cloth, 12s. 6d. (Griffin.) Encyclopædia Metropolitana.)

DANA (R. H.)—The Seaman's Manual; containing a Treatise on Practical Seamanship; with Plates, a Dictionary of Sea Terms, Customs, and Usages of the Merchant Service, Laws relating to the Practical Duties of Master and Marines. 8th edit., revised and corrected in accordance with the most recent Acts of Parliament, by J. H. Brown. 12mo, pp. 240, cloth, 5s. (Moxon.)

ELPHINSTONE (H. C.)—Journal of the Operations conducted by the Corps of Royal Engineers. Published by order of the Secretary of State for War. Part I. 4 vols. pp. 229, 84s.

MARSHALL'S Index Ready-Reckoner; for the Calculation of Wages, &c., from One Quarter of a Day to Thirty Days (advancing by Quarters), at Rates from One Shilling to Five Shillings, especially adapted to the Use of Railway Contractors and any other Parties employing a number of hands, and who require Expedition and Correctness in Calculating Datal and other Labour. 2nd edit., post 8vo, cloth, 2s. 6d. (Longman.)

PAGE (D.)—Handbook of Geological Terms and Geology. Post 8vo, pp. 420, cloth, 6s (Blackwood.)

PHOTOGRAPHS. The Principles and Practice of Harmonious Colouring in Oil, Water, and Photographic Colours, especially as applied to Photographs on Paper, Glass, and Silver Plate. By an Artist-Photographer. 2nd edit., 12mo, pp. 100, cloth 1s. (Kent.)

PLAYFAIR (J.)—Elements of Geometry; containing the First Six Books of Euclid, with Supplement on the Quadrature of the Circle and the Geometry of Solids; to which are added Elements of Plane and Spherical Trigonometry; with Additions by William Wallace. 11th edit., in which the Notes are adapted to Students, and the Treatises on Trigonometry are re-arranged and extended, by the Rev. P. Kelland. 12mo. (Edinburgh), pp. 250, cloth, 5s. (Hamilton.)

RECEIPTS. One Thousand Practical Receipts in the Arts and Sciences, Trade, Manufactures, Chemistry, Domestic Economy, &c. New edit., 12mo., pp. 110, sewed, 1s. (Houlston.)

FEUCHTWANGER.—A Popular Treatise on Gems in reference to their Scientific Value; a Guide for the Teacher of Natural Sciences, the Lapidary, Jeweller, and Amateur; together with a Description of the Elements of Mineralogy, and all Ornamental and Architectural Materials. With Seventeen coloured Plates and numerous Woodcuts. 8vo. (New York.) pp. 563, cloth. 7s. 6d. (London.)

SHAFFNER.—The Telegraph Manual: a complete History and Description of the Semaphoric, Electric Telegraphs of Europe, Asia, Africa, and America, Ancient and Modern; with 656 Illustrations. 8vo. (New York); with 10 Portraits of Eminent Telegraphers. pp. 850. 28s. (London.)

WARD.—A Manual of Naval Tactics; together with a Brief Analytical Analysis of the of the Principal Modern Naval Battles. By James H. Ward, Commander U.S.N.. Author of "Ordnance and Gunnery," and "Steam for the Million." With Illustrations and Diagrams. 8vo (New York), pp. 137. 12s. (London.)

BREES (S. C.)—An Introduction to the Present Practice of Surveying and Levelling: being a Plain Explanation of the Subject, and of the Instruments employed; illustrated with suitable Plans, Sections, and Diagrams, with original engravings of the Field Instrument; with an Appendix, containing such Arithmetical Rules and Examples necessary for the Explanation of the Subject. 8vo. pp. 160, cloth 3s. 6d. (Spon).

FRESENIUS (C. R.)—A System of Instruction in Qualitive Chemical Analysis. 5th edition edited by J. Lloyd Bullock, 8vo. pp. 290, cloth, 9s. (Churchill).

JOHNSTONE (W. H.)—An Elementary Treatise on Logarithms. Illustrated by carefully selected Examples. 12mo. pp. 50, cloth, 2s. 6d. (Longman).

LECTURES delivered at the Bristol Mining School, 1857. 12mo. pp. 306, sewed, 2s.; cloth, 2s. 6d. (Spon).

O'BYRNE'S Naval Manual for 1860. Post 8vo, sewed, 1s (O'Byrne).

PARKINSON (S).—A Treatise on Optics. Post 8vo. pp. 310, cloth, 10s. 6d. (Macmillan).

SLADE (A.)—Maritime States and Military Navies. By Capt. Sir Adolphus Slade, R.N., K.C.B. 8vo. pp. 58, sewed, 1s. (Ridgway).

WILKES (C.)—Theory of the Winds. Accompanied by a Map of the World, showing the Extent and Direction of the Winds; to which is added Sailing Directions for a Voyage round the World, by the same Author. 2nd edition royal 8vo. pp. 120, cloth, 6s. (Trübner).

PLUMBAGO CRUCIBLES.—"England assists nearly the whole of the world in making its money more directly than is generally supposed, the Mints of France, Russia, Spain, Prussia, India, and the Colonies, being indebted to the Patent Plumbago Crucible Works, at Battersea, for the best means of economising their valuable ores. Yet, although the gold purchased by the Bank of England passes in and out of these peculiarly combined smelting pots, our Mint in many respects adheres to the old system. The patent plumbago crucibles are great conductors of heat, and save a large proportion of coke. They are used by Messrs. Rothschilds, &c., for the melting of gold and silver; by the Enfield Government Small Arms Works, and at the Royal Carriage Department at Woolwich, for melting brass; and at the Brest Imperial Works, and in Sheffield and elsewhere, for the more perfect fusion of steel."—*Globe*.

NOTICES TO CORRESPONDENTS.

J. C. F. (*Calcutta*).—Write home. As you are known to Sir Proby Cautly, who is now a Member of Council for Indian Affairs, you had better address your letter to him.

D.—Why trouble yourself about the matter, the amount of nonsense written is beyond belief. We have refused several times, recently, to receive communications upon the subject, and have returned them invariably to their writers.

G.—The subject of your paper is one of considerable interest, and although not so well suited to our pages as for an Astronomical and Mathematical Society, or publications devoted to those sciences, we will make room for it in the next number.

Rouenaise.—The apathy or want of interest exhibited by the English press towards the splendid exhibition of industrial products, of which the city of Rouen was justly so proud, is quite unaccountable, more especially as all the Metropolitan, and most of the leading provincial journals have encouraged the formation of such exhibitions. Political uncertainties, and the very great probability of some rupture between the two countries, have soured the temper of the English press towards Frenchmen and French affairs.

Helice (*Marseilles*).—Griffith's Screw—certainly. Look to the experiments published in the "Artizan" for 1st November.

Grednile.—Fuller's "Telegraph Computer," exhibited at the Institution of Civil Engineers—is in principle a slide rule, and in form identical with McFarlane's "Calculating Planesphere," which was made and sold more than 20 years ago, and may still be seen suspended in the offices of many engineers, merchants, and bankers, both north and south of the Tweed. McFarlane also sold a "calculating cylinder." We have had both of these useful instruments in our possession for the last 19 or 20 years.

R. C. (*Engineer*).—We do not know if the piston you refer to has been sucessfully tried, but Mr. Sinclair's address is, we are informed, No. 2, Cottage, Golden-bridge, Dublin.

R. Campbell (*qy. Cairo*).—The iron vessels constructed, or in course of construction in Aberdeen, are stated to be for the conveyance of cavalry. They are 160ft. long, by 22ft. beam, by 7ft. from deck to floor; they are quite flat, with wall sides, the bottom edges being rounded; there is a sort of gunwale 2ft. high all rouud, above the deck line; the bottom plates are full ½in., the sides, full ⅜in., the rounded corner between bottom and sides is $\frac{3}{16}$in. thick. Their weight is 100 tons each. They are to draw only 17in. when empty, and not exceeding 30in. when fully loaded. They are to be towed.

Geologia.—Send your address. The statement as to coal having been found in Siberia, is perfectly correct; we have the following specimens by us:—No. 1, from the "Nilda" Mine; No. 2, "Spaskie"; Nos. 3 and 4, stones found on each side of No. 2; No. 24, taken from the 5ft. 10in. bed; No. 32, taken from the 28ft. bed. These are all excellent specimens; the coal is of very good quality. The site from which these specimens, and many others have been taken, is on a fork of the River Nura.

Electro-Magnet.—By applying to Mr. Warner of Fleet-street, or Mr. Sandys, Aldersgate-street, City, you will get the information required. You may also write to Mr. Allan, of Adelphi Terrace, Strand. He has given considerable attention to the subject of Electro-Magnetism as a motive power.

Steam Jacket (*Liverpool*).—The assertion is most unaccountably fallacious; but we refer you to a paragraph which has appeared in a weekly Mercantile Journal. The following extract is taken from the *Mining Journal*, Sept. 10th, 1859, p. 630; "The Cornish Engine, and 'Steam Case.' In a letter signed by James Sims, Redruth, 7th Sept., 1859. "No economy of fuel in the 'Steam Case,' and packing destroyed in five weeks, which, without the case, lasted eight or nine *months*. Steam pressure 20 to 50lbs condensing and expanding. But great economy resulted from covering all the pipes, cylinders, &c., with non-conducting materials." (The letter is worth a perusal.)

J. M. (*Gateshead*).—The water pressure engine by Mr. David Joy, of Manchester, has been well received, and is said to have given satisfactory results, with a pressure of 7lbs., and when working slowly has, it is stated, given off 85 per cent. of the effective power of the water. Messrs. Carratt & Marshall, of the Sun Foundry, Leeds, are the manufacturers of these engines. You will on referring back, find much information about Turbines in the early volumes of The Artizan, and more recently we have given reports of Papers on water pressure engines, turbines, and various contrivances for utilizing the power of water.

Gong (*Dublin*).—It happens fortunately that we can supply you with the information as to the best works in any language, on the mixture of metals, and casting of bells: for although the subject is not so immediately "in our line," during the recent discussion at the Institution of Civil Engineers, we became acquainted with the following list of books.

Volks Kalender. By Gubitz, 1846. *Der Volkommenne Glockengiesser*. By J. B. Launcey. This may be had in French or German. *Glockenkunde*, H. Otte, Leipzig, 1858, *Zwolfte Abtheilung. Die Arbeit des Glockengieesser. Die Eisenguss werken*. Berlin, 1827.

Annual Subscriber (*Paris*).—We have received several complaints about the matter. We are not responsible for the acts of your bookseller. The only remedy we know of is to ask him to produce our receipt for your "Annual Subscription paid in advance," according to the terms of our advertisement. If booksellers or agents receive subscriptions for the Artizan, they should immediately forward them to us, and receive the formal receipt, with the register number thereon, as it is only those who are registered in our Subscribers' Book that can be recognised as Subscribers. You will, no doubt, now readily understand the *necessity* for this rule. We ought not to omit mention of the fact that Booksellers and Agents for the Artizan, are not placed in any *less favourable* position, by adopting this *rule*; we record the *number*, and do not require the *name* of the subscriber.

Steam Fire Engines.—The Americans are a-head of us in their attempts to combine a common road locomotive steam-engine, and high-pressure pumps, suited for extinguishing fires in the highest city buildings. They have, as you perceive by references to the last number of the Artizan, had recently a very spirited competition. Send to us your name and address.

Gas.—Apply to Mr. Hughes, C.E., F.G.S., Park-street, Westminster.—We fear the instances you mention are of but too frequent occurrence, and if we are to credit the statements, which, from time to time appear, gas companies are the most wholesale perpetrators of frauds in existence. Messrs. Arntz and Hughes have for many months past been engaged in investigating questions of the kind, connected with the supply of gas to the metropolis.

"High Pressure"; P.R. J. Gover, and Fritz.—The arrangement of coils or series of wrought iron pipes, set in a furnace, and fed with water charged with air forced into it, under regulation as to quantity, known as Scott's Generator, has recently been exhibited in action at the works of Mr. Finney, Engineer, Poplar; it is known in America, as "Black's Aerated Steam Generating Apparatus," and it has been at work in Philadelphia for many months past. Amongst those who have tried "Black's Aerated Steam Generating Apparatus, Messrs Morris, Tasker, and Co., of the Pascal Iron Works, speak well of it. Messrs Scott, Todd & Co., of No. 623, Market Street, Philadelphia, U. S. were the parties who introduced Black's invention. It was patented in America, March 9th, 1858. We presume that Mr. Scott, who has charge of the generator here, is of the firm of Scott, Todd, & Co. Philadelphia. We call attention to Mr. Spencer's paper on Benson's Steam Generator, described at the Mechanical Engineer's, Birmingham.

RECENT LEGAL DECISIONS

AFFECTING THE ARTS, MANUFACTURES, INVENTIONS, &c.

Under this heading we propose giving a succinct summary of such decisions and other proceedings of the Courts of Law, during the preceding month, as may have a distinct and practical bearing on the various departments treated of in our Journal: selecting those cases only which offer some point either of novelty, or of useful application to the manufacturer, the inventor, or the usually—in the intelligence of law matters, at least—less experienced artizan. With this object in view, we shall endeavour, as much as possible, to divest our remarks of all legal technicalities, and to present the substance of those decisions to our readers in a plain, familiar, and intelligible shape.

Protection to Watch-Makers Act.—At the Clerkenwell Police-court, 21st October ultimo, a person was charged with having defrauded Mr. John Johnson Houghton, of five watches, three of which were entrusted to the prisoner to repair, and two to sell. The charge was made under an old Act of Parliament, the 9th Geo. II., passed for the protection of watchmakers, which enacted that where any person being entrusted with a watch to repair, shall sell, pawn, or otherwise dispose of the same, they shall, for the first offence, be liable to a penalty of £20, or fourteen days' imprisonment; and, for a second offence, to three months' imprisonment. The magistrate (Mr. Tyrwhitt) said he was really not aware there was such a statute; but, the offence proved, he convicted the prisoner, ordering him to pay a fine of £20, or be imprisoned and kept to hard labour for fourteen days.

The late Fatal Colliery Explosion in the Maudlin Seam of Washington Old Pit, Durham. The coroner for North Durham has held a lengthened inquiry at Washington, as to the cause of this catastrophe, by which the four pitmen were killed. Mr. Dunn, the government inspector, and others (viewers, miners, &c.), having given their respective opinions as to the cause of the explosion, the jury returned a verdict, "that the explosion was caused by an accumulation of gas in the sixth board, but by what means the gas had escaped, there was not sufficient evidence to show." The viewer had stated his opinion that the gas came from the sixth board at the fall, and either fired on the candle of the boy (one of the victims), or was carried down to where the men were working; which view of the cause of explosion was otherwise confirmed by the other witnesses miners, &c., who had examined the workings.

Spurious Specimens of Auriferous Quartz.—At the Melbourne City Police-court, Australia, a man, named Empson, was lately brought up for obtaining money by false pretences—namely, by the exhibition of spurious specimens of gold quartz, as the alleged produce of certain reefs. The accused admitted having manufactured sundry of such specimens, by fastening a slight quantity of gold into the creviees of quartz stones. On his premises being searched, a number of pieces of quartz were found, apparently in the course of preparation. The excitement which has recently been created in Melbourne by the establishment of new mining companies has, according to the Australian mail, favoured of late the success of this new species of fraud.

Rates on Railways.—The long-pending dispute between the Great Western Company and the local authorities of Paddington has been brought to an amicable adjustment, by the directors submitting to an assessment of the line and property of the Great Western Company, in the parish of Paddington, at £20,000 per annnm. This arrangement was ratified 18th October ult., by an affirmative vote, with but three dissentients, passed at a meeting of the Paddington vestry.

The French Law as to Collisions, &c.—The Paris Tribune of Commerce, 19th October ult., held that, where pilots are in charge of vessels, the captains are relieved from all responsibility, and, consequently, the proprietors also. The question arose on an action brought by the owner of some valuable property, in mosaic and marqueterie, valued at 125,000fr., which was on board the French steamer *Albert*, which, in September, 1857, came into violent collision with the English steamer *Chanticleer*, at the entrance of the port of Copenhagen; on which occasion the *Albert* went down, the passengers and crew escaping with difficulty; and the ten cases of costly furniture alluded to, although ultimately got up from the wreck, were found to have been so greatly damaged by the sea-water that, although originally worth 125,000fr., it would only be sold for 2,000fr. Hence the action for damages against the proprietors of the two vessels, on the ground of negligence in the captains of the two steamers, inasmuch as when the collision took place there was plenty of room in the port; and it was broad day-light. For the defence, it was urged that the accident had been occasioned by the pilots on board the two steamers—one of which vessels was entering the port, the other leaving—having, by mistake, made precisely the same movement at the same time.

The Loss of the "Duke of Richmond" Steamer—[See Casualties to Steamers.]—The official inquiry into the circumstances attending this wreck, held at Aberdeen, terminated on the 4th November ult., when the magistrates exonerated the captain from all blame, and returned him his certificate; but thought the mate was in some degree to blame, and therefore retained his certificate, to be forwarded to the Board of Trade.

The late Percussion Cap Explosion at Birmingham.—The coroner's jury (31st October ult.) found the cause of death in this lamentable case to have been, "divers burns and other injuries, from an explosion of percussion powder; but by what means such powder became ignited there was not sufficient evidence to show: appending their opinion, that Messrs. Pursall and Phillips had not exercised due caution in allowing the dangerous process of "pressing" to be carried on in the immediate vicinity of numerous workpeople, only separated by a thin partition. Further, that the employment of young and inexperienced children in a priming-room is much to be deprecated; concluding with an earnest hope that speedy steps will be taken by the Legislature for the compulsory removal out of towns of all places where dangerous compounds are manufactured. Their technical verdict, however, was one of "Accidental death."

The Wreck of the Jersey Steamer "Express."—The Board of Trade inquiry into the loss of this vessel, belonging to the South-Western Company, was commenced 12th October ult., at the Town-hall, Southampton, before two of the Borough Magistrates and the Nautical Assessor. The steamer left St. Helen's, Jersey, 20th October ult., about 7 a.m., in command of Captain Mabb, with between 150 and 160 passengers. About ten minutes past seven she struck on a reef to the south of the Rocco Tower, near the Corhières. The fore cabin immediately filled. The *Express* was built in three water-tight compartments; the fore-compartment filled with water, but the other two remained perfect. The coast of Jersey being in sight, the ship was run ashore on the other side of the Corhière Rocks, about 100 yards, and the passengers, &c., landed on the rocks. On striking, the steamer was going at full speed—from twelve to thirteen knots. Enquiry adjourned till the 15th, when Captain Mabb was examined, but not on oath, and the presiding commissioner announced the resolution of the court to submit the whole case to the Board of Trade; and the court was again adjourned for a week. The inquest on one of the sufferers, a passenger by the above catastrophe, held at St. Helen's, Jersey, was, after several adjournments, concluded on the 14th October ult., when the jury returned a special verdict, "that deceased was drowned in consequence of the steamer *Express* striking the La Fouquies Rocks; that the loss of the steamer was the result of culpable imprudence and ignorance on the part of the said captain, by his needlessly steering her through a dangerous passage, out of the usual route, and not having at the time a pilot on board, and not being himself a licensed pilot; concluding with a strong recommendation of the authorities of the Island to put, for the future, into execution the law, which enacts that every vessel leaving the island with passengers shall take a licensed pilot on board.

Wreck of the "Royal Charter" Steamer.—The adjourned coroner's jury, held at Moelfra, to enquire into the circumstances under which this fine vessel was lost, returned, on the 3rd November inst., the following verdict:—"From the evidence tendered, we are unanimously of opinion that the deceased, James Walton, and others, unfortunately lost their lives, on board the *Royal Charter*, by pure accident. That Captain Taylor was perfectly sober, and had done all in his power to save the ship and the lives of the passengers.

The Manchester, Sheffield, and Lincolnshire, Railway Company, have appealed in the Court of Queen's Bench against a conviction by the magistrates of Sheffield, for using upon their line a locomotive engine which was not "constructed upon the principle of consuming, and so as to consume its own smoke." The appellants pleaded that the engine was constructed on the best known principle for consuming its own smoke; and the case was ultimately remitted to the magistrates for them to enquire whether or not the smoke arose from the defective construction of the engine.

NOTES AND NOVELTIES.

OUR "NOTES AND NOVELTIES" DEPARTMENT.—A SUGGESTION TO OUR READERS.

We have received many letters from correspondents, both at home and abroad, thanking us for that portion of this Journal in which, under the title of "Notes and Novelties," we present our readers with an epitome of such of the "events of the month preceding" as may in some way affect their interests, so far as their interests are connected with any of the subjects upon which this Journal treats. This epitome, in its preparation, necessitates the expenditure of much time and labour; and as we desire to make it as perfect as possible, more especially with a view of benefiting those of our engineering brethren who reside abroad, we venture to make a suggestion to our subscribers, from which, if acted upon, we shall derive considerable assistance. It is to the effect that we shall be happy to receive local news of interest from all who have the leisure to collect and forward it to us. Those who cannot afford the time to do this would greatly assist our efforts by sending us local newspapers containing articles on, or notices of, any facts connected with Railways, Telegraphs, Harbours, Docks, Canals, Bridges, Military Engineering, Marine Engineering, Shipbuilding, Boilers, Furnaces, Smoke Prevention, Chemistry as applied to the Industrial Arts, Gas and Water Works, Mining, Metallurgy, &c. To save time, all communications for this department should be addressed "19, Salisbury-street, Adelphi, London, W.C." and be forwarded, *as early in the month as possible*, to the Editor.

MISCELLANEOUS.

A Stone-Cutting Machine, of remarkable power and efficiency, the invention of M. Jean Marie, a clock-maker, of Fassieux, in the department of l'Aisne, France, has been recently exhibited in full operation in that locality. It hews, scapples, and carves the hardest stones, with great precision. The bed to receive the stone runs on iron rails, backwards and forwards as may be required. In hollowing out a very hard block of stone, the machine, according to the *Journal de l'Aisne*, performed, in one hour, an operation which would occupy a man three or four days.

One of Bray's Traction-Engines, denominated the "Steam Horse," manufactured by Taylor, of Birkenhead, to supersede the employment of teams of horses in the removal of timber, &c., at the Dockyard, Woolwich, recently steamed down from London, starting from London-bridge at 11 a.m., and reaching the Dockyard at half-past 12. It afterwards proceeded, on test, along the principal thoroughfare of the yard, at a speed of from eight to ten miles per hour, and was subsequently handed over to the authorities. The engine is fitted with springs, to reduce friction. A couple of trucks, to be attached, are in course of construction, for daily use in the yard.

The New Material "Vegetable Leather," as a substitute for animal hides, appears to be making its way into general use. The *United Service Gazette* announces as probable that this new material, the discovery of the Messrs. Spills, army-contractors, of Stepney, will be officially adopted in future contracts for leather leggings for soldiers.

The Withey Trees Cotton Mills of Messrs. Eccles and Co., of Bamber Bridge, about three miles from Preston, with the machinery, consisting of from 16,000 to 17,000 spindles, and 270 looms, have been totally destroyed by fire, supposed to have originated accidentally from a spark from a lamp used in repairing some of the machinery in the third story dropping upou some waste, or amongst some of the cotton, where it smouldered until the departure of the men. Damage estimated at between £14,000 and £15,000.

The Substitution of Machine for Hand Combing has, on the authority of Mr. Alderman Beaumont, in a paper "On the Social Progress and Condition of Bradford," read at the late meeting of the Social Science Association in that town, been of immense value in promoting the general health and longevity of the place; whilst it had added largely to the means of employment and wealth of the community, the local trade being thereby largely extended.

The Surprising Increase of Machinery in our factory districts is evidenced in the case of Bradford, where, in 1801, there was only one mill, having 15-horse power; whilst, in 1850, there were 129, with 2,972-horse power, employing 24,412 persons.

For the Ventilation of Sewers, the City Sewers' Commission, at their meeting at Guildhall, on the 11th October ult., adopted the recommendation of their medical officer of health and the engineer, for fixing charcoal purifiers in the air shafts of the principal sewers, as well as in the pipe-shafts, to be carried up above the houses, at an estimated expense of £700, as an experiment, in the east districts of the city.

A Submarine Tube between Liverpool and Birkenhead. to join a submarine passage across the Mersey, has been recently proposed at the Liverpool Technical Society, by Mr. McArdle. His plan consists of a wrought iron tube, sunk to the bottom of the river, and long enough (about 1,300 yards) to extend from the Liverpool to the Birkenhead side of the river. It would have an outer tube, to be filled with water in sinking it, and ultimately with sand. The cost is estimated at about £105,000. Interiorly, the tube to be divided into two by an upright division, or diaphragm; one side to be used by foot-passengers and the other for railway trains.

The Largest Iron Cable ever manufactured has recently been produced by Messrs. Brown, Lennox, and Co., of Millwall, the manufacturers of anchors and cables for the Admiralty. It is upwards of 40 fathoms in length, being formed of 4½ inch iron, with links 27 inches long, each length weighing 2 cwt. 3 qrs! It is to be used for mooring the large floating coal-ship in Malta harbour; and is of sufficient strength to hold it, with a line-of-battle steam-ship lashed on each side of it, in the roughest weather.

A Submarine Salvage-boat has been experimented upon at Newcastle, Delaware. It is the invention of M. Villeroi, and it descends to the bottom of the river, without any arrangement for receiving a supply of fresh air from above, the boat supplying itself with the quantity of air needed while under water, enabling it to remain submerged for any length of time required. Eight men went down in the boat, and remained there an hour and three-quarters, without any communication from above. The mode of generating air to supply the boat is yet a secret; but it is believed to be by some chemical arrangement. The boat is made of boiler-iron, and is perfectly round, and shaped somewhat like a fish. It is 35 feet long, 44 inches in diameter, and propelled by a screw 3 feet in diameter. It has two rows of bull's eyes on the top, to give light to the interior. On each side, near the bow or head, are pieces of iron, about 18 inches square, which are moved like the fins of a fish, and are intended to direct the boat up or down when under water. According to the *Philadelphia Ledger*, the experiments showed the perfect practicability of the plan of the invention.

A Chimney, 486 feet high has been completed in connection with the Crawford Street Chemical Works at Glasgow. Base, at level of the ground, 34 feet wide, inner diameter there 20 feet, its wall is 5 feet 6 inches thick, exclusive of a coating of fire-brick, 1 foot 6 inches deep, reaching up to about 50 feet on the inside. A million and a half of bricks were required in building it. The estimated cost of putting them over each other, is about £10,000. Each brick is capable of sustaining a pressure equivalent to 90 tons per square foot.

Tunnel-driving.—In constructing the Lock Katrine Aqueduct, recently opened, it was necessary to perform 13 miles of tunnelling, out of the 26 miles lying between Lock Katrine and the great Service reservoir, near Mugdeck Castle. There are in the whole work 70 distinct tunnels, upon which 44 vertical shafts have been sunk for expediting the work. The first tunnel commencing immediately upon the aqueduct, leaving Lock Katrine. It is 2352 yards in length, 600 feet below the summit of the hill, and has been worked in addition to the open ends by 12 shafts, 5 of which are nearly 500 feet deep. This tunnel is in greiss and mica-slate. The last tunnel is at the southern extremity of the aqueduct, just before it enters the service reservoir. It is 2650 yards in length, almost wholly throughout Whinstone, of a depth of 250 feet below the summit of the hill. Besides these (the two longest tunnels) are others, at intermediate places of 700, 800, 1100, and 1400 yards in length. The rock tunnelled through was in most parts of the most obdurate description. For several miles along the side of Lock Chon, where the work passed through a succession of ridges of mica-slate, largely mixed with quartz-veins, the progress did not exceed three lineal yards in a month, although the work was carried on day and night. So truly have these tunnels been driven, that the junctions can only be distinguished by the different directors of the drill-holes.

The Lights Royal Commissioners having completed their examination of the lights and beams on the coast of the United Kingdom, have proceeded to France to visit the principal lighthouses and French coast. Their report will then be presented.

The Steam Machinery for making Ship Biscuit, now generally adopted in the several government establishments, and by the use of which a saving to the country of £30,000 annually is effected, was devised by the recently deceased Sir Thomas Tassell Grant, K.C.B., and F.R.S., late controler of the Victualling and Transport Service in the Admiralty. In recognition of the value of this invention, a grant of £2000 was voted by Parliament, and medals presented to the inventor by the King of the French, and the Society of Arts.

Diving Operations.—On the 3d November, ult., a diver descended down that part of the wreck of the "*Royal Charter*," where it is supposed the specie lies, and brought up a bar of gold, weighing 4lbs.

By the Explosion of the Dupont Powder-Mills, at Wilmington, Delaware. U. S., on the 21st October. ult., 7 lives were lost.

An unusually large Sheet of Plate-glass has been produced for a wine vault's front, in Dale Street Liverpool. The window is surrounded by a half-circular frame, and to accomodate this, a separate place has been used for the upper portion. The plate below measures 145½ inches by 82½ inches, that above 125 inches by 42¾ inches. The total superficies is 126 feet 8 inches, while the thickness is ⅜ of an inch.

The Great Balloon, attempt to cross the Atlantic from New York, has been revived. The Aeronaut had, by last advices begun the inflation of the machine, which is of enormous size. The basket is some 6 or 8 feet in diameter, with an aperture at the bottom, through which, in case of need, the party may descend to a boat carried suspended beneath. This latter is about 40 feet in length, equipped with side-wheels, to be driven by a caloric-engine.

The Coinage of the Syned (New South Wales) Mint is at present, at the rate of £1500,000 per annum.

The "Lumper," or Lifting-apparatus, for which Messrs. Gibbs Bright & Co., the owners of the ill-fated steamer, "*Royal Charter*," had sent to Liverpool, arrived at Moelfra on the 8th November, ult. It is, in appearance, something like a fishing smack. She has a powerful heaving-machine on board, which is worked from the deck, and with which large portions of the wreck can be hoisted from the position in which they lie.

The Splendid Patent Steering-apparatus with which the "*Royal Charter* was fitted, had been hauled up by the divers, in an almost perfect state, a segment of the wheel being the only part broken away. The framework to which the patent steerer was attached, when it stood in its place in the ship, was subsequently got up.

The average velocity of the wind, as registered at the Royal Observatory. Greenwich, during the prevalence of the recent gales (1st and 5th November, ult.) was 24 miles per hour, as measured by Robinson's anemometer. On the former day, the average pressure of the wind was 9lbs on the square foot; its greatest pressure 20lbs.; on the latter day between 4 p.m. and 8 p.m., the average pressure was 10lbs., and there were frequent pressures of 14, 15, 16, and 17lbs. The barometer fell to 28. 64in., on the first, and rose to 28. 68in. on the 2nd November, being the lowest and highest readings respectively, in the week.

In three Gold-ships now on their way from Melbourne, viz., the "*Orwell*," "*Red Jacket*," and "*Swiftshure*," the aggregate amount of gold shipped is 154, 457 ounces.

A Clever Feat in engineering was lately performed by Mr. G. Clark, of Monkwearmouth. After being launched, the steamer *Thames* was taken into the North Dock, when Mr Clark commenced putting in her machinery, consisting of a pair of marine engines, and a tubular boiler about 12 tons weight. The machinery had to be conveyed from the factory in pieces, and it was put together and fixed in the vessel with steam up, and engines in motion in less than 25 hours.

"The Decks of the Great Eastern," says the *Liverpool Albion*, "are only 3½ plank, and will have to be replaced with 4in. or doubled with 2½in. plank; her sleeping cabins are wretched dark, badly ventilated deus, and must all come down. In short she is nothing more nor less than a gigantic imposture below, a fit sample of Thames "jerry" building fixings, the whole demonstrating that limited liability can co-exist with unlimited folly and extravagance. These are the great characteristics of the *Great Eastern*. Liverpool or Clyde shipbuilders, would never have turned out such work." [We wonder whether our Liverpool friend wears spectacles?]

A Church-bell made of glass 14in. high, and 13in. in diameter, has recently been placed in the turret of the chapel at the Grange, Borrowdale, Cumberland.

The engines of H.M.S. "*Retribution*," of 800 horse power, costing £67,246, were taken out in 1850, because found too powerful for the vessel. They were landed at Woolwich, lay there till 1856, were then ordered to be broken up, when for the wrought iron saved, the government received about £1500!

A Model of a Monster Omnibus, has been exhibited on the Bonlevards of Paris, which was accommodate forty-five passengers. The upper part represents a char-a-banc, with two longitudinal benches, with a back common to both. There is likewise a third bench behind the coachman. The "outsiders" are protected from the rain and sun by a screen, which may be raised or lowered at pleasure.

The Cultivation of Cotton in Africa, seems to be making progress. One of the African Chiefs, Ogoubana, has taken to it, and has received a lamp of Sheffield manufacture, from Mr. Clegg, at his own price for 671bs of cotton. Ogoubana has become so civilized, that he now has a brass plate on his door, and knocker, the former having on it his name and title.

A Diving-bell and apparatus was recently shipped from London for the Madras Government. It weighs four tons has a movable grating at the bottom, to prevent accidents from sharks, a set of air-pumps of the best construction, and a double set of glass lenses, with gun-metal protecting gratings, cost £392.

A valuable Invention has just been made in Berlin, by which rifled cannon can be bored in four hours. The government has purchased the invention.

A terrific explosion took place lately in the Sythe and Sickle Manufactory, of Mr. Keeton at Eckington, a village a few miles from Sheffield. The place was almost completely shattered, and after the *debris* had been removed, it was found that the explosion had occurred in the centre of the matting floor, where were the remains of a 5lb. powder barrel, and several fusees. It is supposed to have been the act of some person or persons unknown, with a view to the destruction of the place, though no motive has been suggested for the cowardly outrage. No one was hurt.

In driving piles by Nasmyth's steam pile driver, working at from 60 to 70 blows per minute, the heads of the piles sometimes burst in flame, and burn fiercely.

The great Artesian Boring at Creuzot, France, is the deepest in the world. It was 2808 feet deep in August 1856, and it was then the intention to continue it, if necessary, to a depth of 3281 feet (1000 metres). It was commenced in April, 1853.

A new tree producing gutta percha has been discovered at Surinam. The method of obtaining the juice is this. A kind of gutter of soft clay is made all round the trunk, an incision is then made in the bark to the depth of the liber, when a milky juice oozes out, trickles down into the gutter, and thence into the basin prepared for its reception. In the course of 6 hours the juice coagulates.

RAILWAYS.

On the Chester and Holyhead Railway, the line of rails at Bagillt, was washed away by the sea, on the morning of the 26th October, ult.

Indian Lines—East Indian. This line extending from Calcutta to Allahabad is 1,400 miles in length, exclusive of the Jubbulpore Line; equivalent to a line which should run from London to Pesth, in Hungary, beyond Vienna. The whole of the earthwork and bridges, are announced for completion, to Rajmahal, by autumn of next year.

From Rajmahal to Delhi, the whole of the material for the permanent way of the line, have been for several months past, at Calcutta. The company's difficulty has been to convey them to the works, the Government having monopolized all the modes of conveyance during the late mutiny. The company have sent to India 165,000 tons of rails, 44,000 tons of chains, several tons of ironwork, and, altogether about 245,000 tons of materials for the permanent way; making, with supplies for the bridges, a total of 320,000 tons of material from England, at a cost of £3,500.

Great Indian Peninsula.—Considerable progress has been made on all the different contract sections of this line, within the last few months. The tariff receipts show a great increase in the number of third class passengers; viz., from 1857-8 to 1858-9 from 770,000 to 1,040,000. The works upon the Bhore Ghat, which had been delayed by the failure of the contractor, have since been carried out vigorously by the company's resident engineer, Mr. Ker; including a viaduct which is to a certain extent the key of the whole line; an additional section, between Poonah and Sholapore, will soon be opened to a point near Barsee; being one great step towards effecting a junction with the Madras Line. The Conean portion (88 miles) of the line already open is officially declared to have yielded a profit of 8½ per cent. Materials for no less than 908 miles of this railway have been, and will have to be sent out from this country for the construction of this extensive railway undertaking, which is one of those we may remark *en passant*, to which the late Mr. Robert Stephenson was consulting-engineer. Including the additional works, for which the company are under positive engagements, the total mileage to be constructed is 1,250 miles. Recently the directors paid £443,600 to the Secretary of State for India, in Council, on account for the capital of the undertaking.

The Paris Tunnel of the Saint-Germain Railway under Ballignolles, is to be replaced by an open cutting; the inconvenience of a tunnel of that length close to a terminus used by so many lines having been long felt and acknowledged. The new works, which are to be commenced immediately, will be carried on without interruption to the present traffic.

Of the Santiago and Valpraiso (Chili) Railroad—The continuation, was, on the 8th October, ult., inaugurated at Quillotta, with the usual ceremonies.

The Bahia and San Francisco Railway progresses satisfactorily and rapidly. The first section is expected to be finished according to contract by the end of June next. 1723 persons, were, per latest advice, engaged on the works. Supply of labour, equal to demand.

Between Europe and India, according to the St. Petersburg papers, a line of railway is about to be laid, traversing the Russian possessions.

The Grand Trunk (Canada) Railway is at length, officially announced for opening to Sarnia and Detroit, on the 7th November, ult.

Between St. Etienne and Chamberg, 15 kilometres of the railway have recently been swept away by a mountain-torrent.

Four Locomotive-engines, together with carriages, waggons, and other rolling-stock and materials, recently shipped from London for the Baroda Railway at Bombay, on board the "Jessica," 856 tons burdone (owners, Messrs. J. and R. Wilson, of Liverpool), have been lost by shipwreck; the ship, when in Lat. 10° S. Long. 25·39° W., having sprung a leak and gone down, all hands escaping by the boats.

South Australia.—In Adelaide the Government have recently advertised for tenders for the survey of a line of Grand-trunk Railway, so as to develope and open up the mineral and pastoral resources of the north of the colony.

The Mount Cenis Tunnel advances slowly, but steadily. In the 22 months elapsed since the commencement of this stupendous work, a length of 820 mètres has been pierced, two-thirds of which have been arched over with masonry. Amongst the numerous engineering difficulties which have had to be surmounted, may be enumerated, the construction of a road two kilomètres long, between the mouth of the gallery and the Onix and Bardoniche-road, a canal from the torrent Rochemolles, and another from the torrent Melezet, to convey the waters required to act as a motive force to effect the compression of the air, an observatory for the tracing out of the axis of the tunnel, and subsequent verifications; store-houses, for the wood, iron, mortar, and other building materials; sheds for the perforating-engines, &c., workshops for repairs of engines and utensils; a large edifice containing the engines for compressing the air, and two others containing reservoirs; a powder-magazine; and lodgings for the workmen, and higher officials, in addition to permanent quarters, near the the mouth of the gallery for guards and assistants.

A new Railway in the City—The London Dover and Chatham—is being organised. The company propose to carry their line over the Thames; and by means of an arch, over Ludgate-hill, to proceed to the eastern side of Farringdon-street, where a space is to be cleared for a terminus.

The extent of Railway Lines in France is now actually greater than in Great Britain. France now possesses 8,700 kilometres of railway (the kilometre is ⅝ of a mile), which have cost nearly 4,000,000,000 francs, of which 3,250,000,000 francs were raised by public companies, and 750,000,000 francs by state.

The first Railway in Western Asia—The Ottoman, Smyrna, and Aidin—is in active progress towards completion. Its contractor is an Englishman, Mr. J. R. Crampton; most of the workmen, navvies, &c., are natives. The works indeed, are now so far advaneed that in the early part of October last, a trial-trip with the Prince of Wales and party as passengers, was made, from the Smyrna Station to the furthest point of the works as yet deemed to be sufficiently completed (a distance on the line of about 15 miles), passing through the Boudjab Fort, from Smyrna, and Seydikeni Stations.

The Coast Railways have been, by the disastrous gales at the close of October last, in several places carried away, or so far destroyed as to interrupt the regular course of traffic.

Between Chester and Birkenhead the railway was bodily washed away at several points on the line.

Between Conway and Bangor, on the Holyhead Line, an embankment was washed away, the surf carrying before it both sea-wall and outer line of rails. In consequence of the interruption of traffic, thus caused, passengers for Holyhead had to dismount, and continue the journey by coach, round the steep headland of Penmænmaur, re-entering the train at about three miles beyond Conway.

Near Rhyl about a dozen yards of the line were completely washed away and 100 yards damaged, the passengers having to walk some distance to get to the train on either side of the disruption.

On the South Devon Railroad, the sea broke in at four different points; on the river Teign, in front of Delamere House, the granite coping was washed down for 200 yards: above East-Teignmouth both sea-walls were broken for a quarter of a mile: at Ganston Point, between Dawlish and Starcross, there was another breach; and above Starcross, between Turf and Powderham, the embankment was destroyed for more than half a mile, and the ballast washed from under the rails.

On the South Coast Railway, between St. Leonards and round Bexhill, a large portion of the line was washed away, and all the trains, up and down were delayed.

Engines Behind Trains.—The express train from Scotland, consisting of eight carriages, had, on the afternoon of the 11th October, ult., arrived near Carlisle (on the Lancashire and Carlisle Railway). For helping heavy trains up a steep incline, about a mile from the city, it customary to put on, usually at the end of the train, an assistant-engine. On this occasion, the driver of the auxiliary engine, not aware that the express train had for some reason unexplained, suddenly shut off steam, ran his own engine along at his usual speed, and consequently dashed into the end of the train. By the concussion, several of the passengers were more or less bruised and shaken; but fortunately the only damage received by the train, was a broken buffer on the last carriage. The accident, however, may probably serve to put a stop in future to the practice of sending engines behind trains.

On the Line. A fatal accident occurred on the 15th October, ult., to an inspector of the Lancashire and Yorkshire Company's station at Bolton. Deceased was slowly walking along the line of rails near the Cross Over-bridge, giving some directions as to shunting some carriages, when an engine came up, running tender first, knocking him down, and mangling him so frightfully, that before he could be removed from the station he expired.

The Chester and Holyhead Express-train, on the 16th October, ult., ran into the Llandudno train, which having just arrived, was shunting from the down to the up-line; the express-train was to have stopped at the latter station, but the velocity of its motion carried it some 90 yards beyond the platform—hence the concussion. Two of the Llandudno carriages were thrown off the line, and several of the passengers were more or less bruised. A delay of upwards of an hour occurred before the injured carriages could be removed so as to enable the express train to proceed on its journey towards Chester.

The "Ganges," China Mail Steamer, of the Peninsular and Oriental Company, had, on her recent run to Point de Galle, to put into Trincomalee, short of coals; whereby the *Bengal* which left Aden for Suez on the 15th October, ult., was delayed at Point de Galle for the arrival of the former steamer with the China Mail.

On the Cairo to Suez Railway, the train in which the Viceroy of Egypt was travelling, came into collision, recently, with that coming in an opposite direction. Fortunately the engine-drivers were able to check the speed of their trains in time; and the shock was but trifling. The railway-officials have in consequence, incurred the high displeasure of his highness for their carelessness.

On the Midland Railway, an alarming accident occurred involving an enormous loss of property. A coal-train from Clay-cross to Peterborough, was passing over the wooden pile bridge at Messrs. Street's dam, when the axle of one of the coal-waggons broke; and 25 the number were precipitated into the stream.

The Waveney Valley Works are progressing rapidly between Harleston and Bungay. It is proposed to extend the line from Bungay to Beccles, where a junction will be effected with the East Suffolk line.

A new system of Railway signalling has been tried on the line between Bickershaw collieries and Leigh. The inventor (Mr. Batty of Longsight) proposes to make the weather-board a screen of plate-glass, and attached to each side of it, and projecting over the frame of the engine, mirrors or reflectors about 2ft. square, which may be firmly fixed at any given angle, by a very simple contrivance. By means of these reflectors, the driver has a view of the whole line of carriages, so that in case of accident, the "danger" lamp projected from the guard's van, must immediately attract his attention. One feature in the plan is its comparative cheapness, the cost of applying it to an ordinary locomotive not exceeding £5.

The Welwyn Viaduct on the Great Northern Railway, is 1562ft. long, and 100ft high. It has 40 arches of 30½ft span. Cost about £40,000.

The Ballochmoyle Viaduct of the Glasgow and South-Western Railway, has one stone arch of 180ft. span, the widest ever constructed in masonry for the passage of a railway.

The Railway Viaduct across the lagunes of Venice is 11,805ft., or nearly 2¼ miles long. It has 210 arches of 33ft. 4in. span each, rising 18ft. 4in. from the sea. Cost £180,000.

The flanges of the leading wheels of ordinary 6 wheeled engines have to be turned anew every 6 weeks on lines of railway, having frequent sharp curves.

Owing to some neglect at the points at the Wicker station, on the Manchester, Sheffield, and Lincolnshire Railway, a passenger train ran into a stationary coal train recently. The collision was fearful. Several persons were dangerously hurt.

The Northern Railway of France, on which are employed some of the largest locomotives ever constructed is being partly relaid with flat-footed rails, spiked directly to the sleepers, the joints being fished and no chairs being used.

In working trains through curves of 300ft. radius on the Virginia Central Railway, U. S., a sponge saturated with oil is kept constantly pressed against the flange of each wheel, an arrangement which is found materially to diminish the resistance.

The Engine "Liverpool," built by Bury and Co., for the London, and North-Western Railway, has 18in. cylinders, 24 in stroke, one pair of 8ft. driving wheels, the boiler containing 300 tubes 2$\frac{3}{16}$in. in diameter, and 2ft. 3in. long, the total heating surface in the tubes, and fire box is 2100ft.

The Goltzsch Viaduct of the Saxo-Bavarian Railway, between Reichenbach and Planen, is built of brick, with 4 stories of arches, the widest 100ft. span. The length of the viaduct is 1903ft. and its height 264ft. Cost £271,540.

On some of the American railways, the whistle is sonnded at crossings, and elsewhere by automatic mechanism connected with the wheels of the engine. The revolutions of the wheels corresponding to the distance traversed, they are connected to a barrel like that of a music-box, and the whistle is blown whenever a stop in this barrel has been brought in contact with the lever by which the whistlecock is opened.

On the occasion of the opening of the Madras Railway in the Malabar district, the natives crowded to see the trial trip of the "smoke bandy," which travelled at the rate of 30 miles an hour. The women signified their reverence by salaming to it, and many of the men strove hard to keep np with it. New signal men had been drilled to their work, and placed at every mile of the line, but several of them on the approach of the engine, threw down their flags and took to their heels.

A Terrible Accident occured lately at Oldham. A tailor named Coop had gone into the place where some coach builders have their bay cutting machine which runs by steam, and commenced feeding it with hay. While so doing his arm was drawn into the machine, which was stopped as soon as possible. His arm was cut off a short distance below the elbow, and the bone completely shattered.

The Aqueduct at Spoletta in Italy, has 10 gothic arches of a span of 70ft. 4in. each, supporting a second series of smaller arches. The height from the water to the top of the parapet is 426ft. 6in., being nearly twice that of any other aqueduct ever constructed, except that at Roquefavour, in France, which stands 270ft. above the water.

The Nominal Horse Power of a steam engine is found by the Admiralty rule, by multiplying the square of the cylinder's diameter in inches, by the velocity of the piston, and dividing the product by 6.000. The velocity of the piston is assumed to be—viz., for a 4ft. stroke, 196ft. per minute; 4½ft. stroke, 204ft.; 5ft., 210ft.; 5½ft., 216ft.; 6ft,, 222ft.; 7ft., 231ft.; 7½ft., 236ft.; and an 8ft. stroke, 240ft., per minute.

Electro-galvanism, as a cure for the cholera, has been tried by Dr. Defontaine of Mons with great success, fifteen persons attacked with cholera, and whose lives were despaired of, were all, without exception saved.

The "Royal Charter" is supposed to have had on board in gold, in freight, and in private bonds, at least half a million sterling, when it went down.

Of the "Glasgow" Screw Frigate, of 51 guns, now being laid down on the slip at Portsmouth, where the *Bacchante* was lately launched, the following are the principal dimensions: Length between perpendiculars, 250ft; ditto of keel for tonnage, 214ft. 7in.; breadth, extreme, 52ft.; ditto for tonnage, 51ft. 6in.; ditto moulded, 50ft. 8in.; burthen in tons, 3027, 50,294.

The "Victoria," 3-decker, launched on 21st. November ult., (vide "Launches of Steamers," present No.,) is the greatest in length of any now building in Portsmouth yard: it exceeds the Glasgow in length, by 8 feet.

The Decks of Iron-Steamers are with great difficulty kept tight, owing to the contraction and expansion of the iron. Practically, the best course is found to be the doubling the decks with very thick planks, laid diagonally. The usual expedient of caulking, is, in most cases, found to be but partially efficient.

The Moorings for the Great Eastern in Southampton Waters, (supplied by order of the Admiralty, from Portsmouth Dockyard, consist of 2 anchors, of about 90cwt. each; 2 blocks, of about 7 tons each; and 130 fathoms of the heaviest mooring-chain, with a 22cwt. swivel. The mooring chains of 4½ inches square; the ship rides to a swivel, on a "bull ring," the mooring chain being laid in the form of a cross, np and down, and across the stream. The chains going up and down, are secured by 2 iron mooring lumps of 8 tons each; with 2 shackles of 3 tons more, backed by 2 anchors of 98 cwt. each, without a stock. Those across the stream, where intide-way is to be dreaded, are secured by anchors. The spot selected for her winter berth is about a half a mile distant from the new military hospital at Netley, about 2½ miles from Southampton, where the Channel is 750 yards wide, so that snpposing the big ship to swing either way, there will be left plenty of water for the largest class steam ships to pass between her and the 5 fathom lines; and as she will be tautly moored to the middle, she will ride freely and securely under all circumstances, as there will be 450ft. on one side,, and 1,125ft. on the other. The great ship will be moored by 4 of the heaviest class mooring anchors, placed at right angles, and connected in the middle, with a large ring and swivel of the strongest description, to which will be attached the tredles that the ship will shackle her chains to. The anchors of the north and south arms of the moorings are respectively, 98. and 87cwt., with 70 fathoms of chain to each: those of the east and west arms, are 8 tons each with 60 fathoms of chain to each.

The "Dasher," Paddle, tested machinery 2nd November, ult., at Portsmouth. Trial satisfactory.

The "Trident" Iron Paddle-wheel War Steamer, was, on the 2nd November, inspected at Woolwich. Engines found to be in good working condition. Iron hull, still considered good; bnt the waterways and some of the beams found rotten and decayed.

The "Great Eastern," left Holyhead for Southampton, between 12 and 1 o'clock, on the 2nd November ult., and reached her winter moorings in the latter harbour, November 4th, about 9 a.m. Towards the completion of her course the Patent Log Register shewed a distance run of more than 31 knots in two hours. During this latter trial, the paddle had been gradually worked up to 12½ revolutions a minute; the steam in the boilers being about 22 lb., and in the engines at about 20 lb.; the highest which had previously been attained with these (the paddle) engines, was short of 11 per minute, though expected to do 14.

The "South Western," a small English steamer recently employed in the Barbary trade, has been sold to the Pacha of Tripoli, for £4,500, to be used by the Pacha, as a mail boat between Malta and Tripoli.

A New Cunard Liner, to be called the *Scotia*, iron paddle steamer of 4,000 tons, with corresponding horse power, and in every way larger and more powerful than the *Persia*, which is 3,500 tons, has just been contracted for by the Cunard Company, with Messrs. Napier of Glasgow.

The "Thebes" English Steamer, chartered by the French Government, late advices from Cochin China, was wrecked on the 30th August last, on her way from thence to Turon. No lives were lost.

All the Steam Ships of War in Plymouth Sound, during the prevalence of the late violent gales, of the 1st November, ult., had their engines at work to ease the strain on their cables.

The United Company's Steam packets, were, on the same occasion unable to make their usual passage between Ryde and Portsmouth.

The "African" Screw Steam-Ship was severely damaged by the gale of the 2nd November, ult., and obliged to put into Padstow Harbour. Five persons were washed overboard, viz., the captain, first engineer, second engineer, the carpenter, and one seaman. The funnel was blown down, and the engine-room filled with water.

The "Shamrock," Screw Steamer, of Dublin, during a hurricane, between 11 and 12 on the morning of the 1st November, ult., went on the Holm Sand, and hoisted a flag of distress. Crew saved by means of a life-boat and lines.

The Propeller "Troy," foundered on Lake Huron, U.S., during the late gale; and, owing to the crowding into the boats, 18 lives were lost.

The "Duke of Richmond," Steamer, belonging to the Aberdeen, Leith, and Clyde Shipping Company, ran ashore, 8th October, ult., a few miles northwards of Aberdeen, and became a hopeless wreck in the sands. Passengers (140) got safely ashore, by boats, steam-tugs, &c. Of the 40 head of cattle on board, between decks, between 20 and 30 perished, it being found impossible to remove them.

The "Bombay" Austrian Lloyd's Steamer, coming from Constantinople, ran ashore on the 9th November, ult., near the Island of Unie, in the Bay of Juanerio, in Austrian Illyria, passengers, specie, and letters saved. General Steanes left the Port of Trieste, to render assistance.

The "Royal Albert" Steamship, 121, flag of Sir Charles Fremantle has had to repair to Plymouth, leaky, and with some defects to make good.

The "Odin," Steam Frigate, 16, steamed into Hamaze, 13th November ult., to make good defects, which are numerons, considering that she has just left her port of equipment. Her rudder is said to be defective.

TELEGRAPH ENGINEERING.

The Channel Islands Snbmarine Cable (to Jersey and Guernsey), is again in working order. The flaw was discovered about three quarters of a mile out, in the thick shore-end of the original cable, one mile and a half of which was carefully examined and repaired; and with a mile of new and stronger cable, relaid in conjunction with the heavy shore-end laid down last spring. The new portion is the same as that recently submerged, in the Red Sea, and is stronger than the Jersey Cable.

From St. Petersburg to Pekin (China) the Telegraphic line appears to be in actual progress of construction, as by late advices from Houg-Kong, the Russian steamer *America*, having on board several engineer officers, had arrived, on the 16th July, at Pehtang coming from Hakodadi. Two engineers proceeded on the 22nd July, to Pekin, to make preparations for the telegraphic line from that place, to the Russian territory.

The Transmundane Telegraph, the latest American novelty in telegraphs, and projected by a Major P. Mc Donald Collins, is approvingly spoken of by the *New York Herald*. The Major, it appears, has already proceeded to St. Petersburg to lay his project before the emperor, and to solicit his aid in carrying out the enterprise. As to the Japanese Emperor, his consent is represented as all but certain, as regards that portion which is to connect his dominions with the main line; whilst the hope is entertained of easily obtaining the consent of the Chinese Imperial Government to the construction of another lateral branch, communicating with Pekin.

The Turkish Government has recently announced its intention of annulling that clause of Messrs. Newall and Co's concession, which gives them the exclusive privilege of landing a cable at Alexandria; a clause which, as it stood, virtually conferred an absolnte monopoly of all telegraphic communication with the East by way of Alexandria; so that no foreign government, or any other company, could land a cable in Egpyt. The effect of the alteration is, that England or any other power, may, with the sanction of the Porte, land at Alexandria, between that and any place out of the Turkish dominions. Bnt, between Alexandria and every other part of the Ottoman Empire, Messrs. Newall and Co., still retain their exclusive privilege.

Candia to Alexandria. The attempt, (by Messrs. Newall & Co.,) to lay the snbmarine cable, having failed, the projectors resolved on connecting Alexandria with the European lines of telegraph, by way of Chios, Rhodes, and Cyprus. The arrival of the necessary Firman from the Turkish government, however, having, notwithstanding the promise of its speedy expedition, been from time to time postponed through official delays, Another attempt at laying the cable between Candia and Alexandria has been resolved upon. Subsequently, this attempt having again failed, the laying the cable from Candia to within 70 miles from Alexandria, proved successful, the deepest water having all been passed over, when a flaw of insulation was discovered, which suspended the operation of paying out. The flaw was abont 20 miles from the ship; and when the cable was picked up, to within about 3 miles of it, it parted in about 1,500 fathoms of water.

Colonial Telegraph Lines. Between Kings Island and Cape Otway, Victoria, the cable has been successfully laid; the continuation of it, thence to the Hammocks, and from the latter point to Circular Head, and so forward to George Town, was per last advices, fully expected to be accomplished in a few days; thus completing the chain of telegraphic communication between Tasmania, Victoria, New South Wales, and South Australia.

Between Holyhead and Liverpool, communication was temporarily interrupted by the blowing down of the telegraph wires, during the late disastrous gale in which the *Royal Charter* steamer, went down.

At Harper's Ferry on the Frontier of Maryland and Virginia, U. S., all the telegraph wires (of which there are several converging from various directions,) leading to that spot have (recent advices from New York) been cut by the Negroes, who broke out into insurrection, and seized the United States arsenal there.

For the Submarine Telegraph to Tasmania viâ Cape Otway, the local Melbourn Parliament has voted 17,000 for the extension of main lines, £8,000; new station and repairs £7,600; repairs and improvements, £7,000.

To connect Southern Australia with India and China, an overland telegraph is in serious contemplation. From Adelaide, two exploring parties were, per late advices, abont to attempt crossing in a north-westerly direction, to the gulf of Carpentare, in connection with this undertaking.

The Electric Company's Cable across the Humber, which was broken during the late gales, has been repaired, and is now again in working order.

Suez and Aden.—The electric cable between Suez and Aden has been laid down by the *Cyclops*. From Aden the wires are to be carried to Schugra; then through Hadramaut, a province of Southern Arabia; then to the Isle of Socotora, at 250 miles from the Straits of Babel Mandeb; and then by the Isle of Ceylon, and the Gulf of Bengal to Calcutta. When completed, the total length of the line of cable submerged will be 3,750 miles.

MILITARY ENGINEERING.

Cast-Iron Ordnance.—One of the experimental cast-iron ordnance, termed a "Shunting Gun," turned out at the Royal Gun Factory at Woolwich Arsenal, and rifled on Sir William Armstrong's principle, has recently been tested at Shoeburyness, and burst under trial. This, together with the result of other experiments, has led to the conclusion that cast-iron ordnance are not of sufficient endurance to resist the shock and concussion produced by the rifle-bore; and that wrought-iron alone is applicable for that purpose.

The Royal Gun-Factory Establishments in Woolwich Arsenal are about to be entirely remodelled; an immediate cessation of casting guns of every description having been decided on, in order to give place to the introduction of Sir William Armstrong's method on the most extended possible scale. The whole of the Royal gun factories are, in cousequence, to be transferred to the new Rifled-Ordnance Department; the casting-metal on hand, as well as the unfinished brass guns, are ordered to be handed over to the Laboratory, to be appropriated to other purposes.

The Casting Furnaces, recently erected at the Woolwich Arsenal Royal Gun Factory, are to be employed in the manufacture of shells, and other purposes—(than gun-casting, henceforth to be discontinued)—and the artillery officers counected with the department will return to their military dnties.

Spanish Ordnance.—Twenty-four pieces of rifled cannon have been prepared at the foundry of Seville, for the expedition to Morocco. The Duke of Montpensier has borne the expense.

The New Liscard Batteries, for the defence of the Mersey, have been completed. They are earth-work batteries, constructed according to the newest principles of engineering, with bomb-proof magazines, and platforms for seven 68-pound Armstrong guns, which will shortly be in position. The battery is so masked, that an enemy would have first bored to a depth of $21\frac{1}{2}$ft; this hole was charged with about 43lbs. of powder, and fired by the ordinary mode of squib and match. This had the effect of considerably rending the rock. The next operation was to charge the hole a second time, and about 305 lbs. of great difficulty in discerning it before the effect of its fire had worked awful damage. At present, its range is rather limited; but, in case of actual danger, the removal of some adjacent buildings would enable the gunners to throw 68-pound shot over the New Brighton Stage, into the Victoria Channel, or into the Sloyne. It is posted opposite the Huskisson Dock Battery. Its green mounds are immediately in the rear of the Magazine Life-boat House, on the Cheshire side.

For Shipping Shot and Shell, of the largest size now in use, the "Boxer Slides" are now adopted in Woolwich Arsenal. The shot and shell are seen rolling from the factories to the water's edge by means of these slides; being thus shipped with great rapidity on board the various light schooners waiting in readiness to receive them *en route*, the majority of them, at present, for the West; whence those destined for China are transhipped for their destination. Upwards of 1000 tons are now (November) ready for departure.

For the Defence of our Australian Colonies, six vessels of war, varying from six to 26 guns—the whole armament, comprising 82 guns, and 1000 men are to be stationed in Australian Ports. Three batteries are to be erected in Hobson's Bay, mounting 30 guns. Three Martello towers, and two forts are to be erected at the Heads, mounting Armstrong guns, and an ample supply of arms has been ordered from England. The first outlay will be £140,000. These details have, recently been officially communicated by the Colonial Chief Secretary, to members of the Chamber of Commerce.

Molten-Iron for hollow shot. The *Stork*, gun-boat, tender to the *Excellent*, gunnery-ship, at Portsmouth, is being fitted in the steam-basin with one of the Cupola furnaces for the filling of hollow shot with molten iron.

For the new Drop, and Fortifications at Dover Heights, the contract has been taken by Messrs. Stiff and Richardson, who have commenced operations. Works to be completed by the 31st March.

Chinese Guns—Amongst the curious specimens of Chinese (captured) ordnance, recently deposited at Woolwich Arsenal, is an iron cylinder, which has been used as a gun (of about the calibre of our 12-pounders) having a number of thick rings or hoops, down the length of the barrel. It has the appearance of having been some time immersed in water; and is thoroughly eaten into with rust and corrosion.

DOCKS, HARBOURS, &c.

In the Victoria Docks, 16th October ult., the iron Ship *Howden* 1,353 tons, Liverpool, capsized and sunk in the centre of the dock-basin, in 22ft. of water. A sudden south-westerly squall caught the ship at her mooring fronting the graving dock, where she had been hauled off the pontoon on which she had had her bottom overhauled, and re-painted and threw her completely over on her larboard side on her beam ends, her ballast-ports and dead lights being open, the water poured into the hold, and everything was carried to leeward: she filled fast, and finally settled down on her beam end with her starboard side about 12 feet above the surface, and her mast partly submerged. The dock Company engaged the Derrick, and a large number of powerful lighters for the purpose of raising her.

Portsmouth Dock-Yard did not altogether escape damage from the extreme violence of the gales of the 18th November ult. One of the plates, and a girder of a portion of the shed from under which the *Victoria* 3-decker was waiting to be launched were fractured from the almost unprecedented violence of the wind. The signal flag was hoisted all day on the Semaphore in the dock-yard, interdicting all communication by man-of-war's boats, between the harbour and Spithead. The barometer had fallen $\frac{8}{10}$ths. since the preceding evening.

To Milford Haven, a railway from Llanidloes, 51 miles in length, is being surveyed with a view of completing a link of communication between Manchester and Milford Haven, via Llanidloes, Lampeter and Carmarthen. Estimated cost, £500,000.

The Suez Canal is according to an official communication from the viceroy to the consuls at Alexandria, (advices to the 11th October, ult.,) to be completed by the Porte, which will henceforth assume the responsibility of the undertaking towards Europe. The European workmen employed on the works, at Suez, were, in consequence of this intimation, to leave the place before the 1st November.

The Portland Breakwater has sustained considerable damage from the late hurricanes; the temporary wood-work of the breakwater was most disturbed. The greatest damage was to about 600yds. from the shore, near the first pier head, where an immense gap of about 200ft. in length, was made in the support, the timber from which, was thrown on the shore, in all directions. The communication to the outer or great Breakwater, being thus cut off, the depositing of stone would have to cease, until the repairs be effected.

Of Southampton Harbour, the safety and security have been established by the fact that during the late severe gales, probably the severest ever known, when scarcely a single port on our coasts escaped from contributing its quota to the painful catalogue of nautical calamities, the whole of the shipping in Southampton Harbour, including the magnificent mail steamer in dock, rode in safety, and not a single casualty occurred in any part of the Harbour.

The Suez Canal.—The *Patrie* of the 12th October ult., announced that an envoy of the Sultan had arrived at Alexandria bearing an order to the Viceroy of Egypt, to oppose the continuation of the works of this canal, and that the foreign consuls had immediately assembled.

The New Glasgow [from Lock Katrine] Waterworks, were, 14th October ult., opened in State by Her Majesty. The ceremony of opening the aqueduct which is to convey the waters of Lock Katrine to Glasgow, a distance of 37 miles, passed off well in the presence of a large concourse; Her Majesty being accompanied by the Duke of Newcastle, and received by the Lord Provost, and magistrates of Glasgow; the Dukes of Montrose and Atholl, the Earl of Mansfield, &c. The seretary to the water commission read an address from the corporation, to which Her Majesty returned a sensible reply, expressive of her gratification in inaugurating a work calculated to improve the health and comfort of the vast population, rapidly increasing round the great centre of manufacturing industry.

The Madras Irrigation and Canal scheme was originally projected by Mr. John Westwood, to establish a system of irrigation in India, in combination with the benefits of canal transport of cotton, indigo, &c. The proposal ultimately received the sanction of both the home and local legislature, and works are about to be commenced under the encouragement of a government guarantee. The Madras Presidency contains 130,000 superficial square miles: and of this, only a small portion is irrigated, although $11\frac{9}{20}$ are susceptible of cultivation; the expense of transport of one article of produce, cotton, to the seaports was so great, that the cultivators could not afford to pay for it—being no less than $\frac{1}{2}$d. per lb. By means of water communication, it will, hereafter, be conveyed for $\frac{1}{20}$ of a penny per lb. The intention of the company is to avail themselves of the waters of the Toongabuddra, a river half a mile in breadth and an average depth of 15ft. This will be connected by suitable channels with another river, and so be carried up to Madras. The area which the Company proposed to irrigate, comprised 2,000,000 of acres, being double that of the county of Essex. The project was subjected to the Government in 1857, and, by them referred to the Madras Local Government; the result was, that the scheme was finally sanctioned. When the surveys are concluded, the construction of the works is to be entered upon as early as possible.

Of the Breakwater-Works at Holyhead, a large part has been destroyed during the late violent gale, vessels, anchored or inside, and, comparatively sheltered, went down bodily, or were driven high and dry ashore. Several lengths of huge timber framework at the end of the breakwater, were swept away by the waves; together with the cranes and machinery at top. The whole harbour was strewed with the débris. Even at the point were the breakwater makes an inward curve, the cranes upon the high scaffolding were damaged by the waves, which bere broke so high and fiercely, as for the time, to threaten a clean breach into the harbour itself.

Drainage of the Maremme Marshes [Tuscany]. The Tuscan Government have lately offered a prize of 1,500 francs to the author of the best essay on the draining of these, hitherto considered, incurable marshes, a commission to examine which had been some time since appointed, but the purport of whose report has not yet been made public.

The Benefits of Irrigation, as enhancing the value of land, were forcibly instanced by the contents of a document read by the chairman (James Thompson, Esq.) at the recent meeting of the Madras Irrigation and Canal Company, the branch of the facts adduced, being corroborated by Colonel Onslow. It appeared that in the districts (of the Madras Presidency) already irrigated, the value of land had increased, in one place, 18 per cent: in another, 53: in a third, 62: a 4th 32: in a 5th 166; a 6th 164: and, in one case, 211 per cent.

The Large Southampton Graving-Dock, one of the most extensive in the world was made for the *Himalaya*, now no longer looked upon as a big ship, equalled as she is, in length, by many of the modern ships—surpassed by the *Tasmania* and others, and completely dwarfed by the *Great Eastern*.

A New Graving Dock expressly for the *Great Eastern*, to be constructed at Southampton, or rather, an enlargement of the Dock Company's present great graving-dock, is in serious contemplation. The cost would be about £80,000; the condition of constructing it being, that Southampton be made the permanent port of call for the Leviathan Steamer. The enlarged graving-dock would have two entrances, one in the West Dock, and the other from Southampton Water, close to the western side of the mouth of the Itchen River. Locks to be placed in the dock, by which the *Great Eastern* could be docked at any time, without interfering with the accommodation of other ships. The present steam-pumping machinery would be sufficient to pump the water from the enlarged dock.

The Docks at Liverpool now comprise 240 acres of water—area, and 15 miles of lineal quay space, at a cost of about £7,000,000.

The Docks at Birkenhead, when completed, will furnish a water-area of 170 acres, and a lineal quay, space of 9 miles, at a cost of £3,000,000.

The Canal, versus Railroad Interest in Canada. The people of Oswego have been recently calling on the Canadian Government to enlarge the Walland Canal, to benefit their shipping; but the policy of Canada, now that the railway system renders her independent of the United States, is understood to be close the canal.

BRIDGES.

Railway Bridge building in India. On the East-Indian Line, several of which are more extensive than any structures of the kind in Europe, the engineers have had to contend with extraordinary local difficulties, in constructing their bridges. The authorized line, along the valley of the Ganges has had to cross, at right angles, several vast rivers running into the Ganges; the nature of the soil in many places, rendering it very difficult to obtain good foundations for their bridges. On the line from Calcutta to Rajmabal, first 20 miles, the river Adjai had to be crossed with a bridge of 32 openings, of 50ft. span each. It has been completed, trains are now running over it; across the river More, a bridge of 24 arches, each of 50ft span, is being constructed, and will shortly be completed. On certain sections, the line has to be carried on arches, over a country which is flooded at certain times of the year, and for a considerable extent, resembles the Greenwich Railway. All the bricks have had to be made for it, no stone being obtainable in the district.

New Westminster Bridge is still steadily, though slowly making progress. The whole of the iron work wrought and cast, of the first half of the arches has been finished; the buckle-plates have been bolted down for the roadway, and a portion of the macadamized road, at either end constructed. For the road, a series of wrought iron convex plates, about 7ft. by 5ft., is bolted on to the ribs of the arch. The intervals between the convex crowns of these, are filled in with a wood-pavement, the interstices of which are closed in with strong asphalte, till all is perfectly laid with the top of the plates. A coating of dry brick rubbish to the depth of 8 or 9 inches, is then laid down, with a layer of granite over all. Both portions of the abutments of the Middlesex and Surrey sides have been thus finished; but the granite has not yet been laid over the intermediate arches. When the whole bridge is finished, the heavy waggon tramways (one on each division of the roadway) will be close to the curb at either side, while a slight curbstone division, with lamps above the very centre of the bridge, will totally divide all traffic going to the North and South sides of the river.

GAS ENGINEERING.

A new "Sliding Gas-Chandelier," the invention of Mr. Hughes, of the Atlas works Hatton Garden, was exhibited at a recent opening meeting of the Architectural Association in Conduit Street. A whistle in the throat of the tube of the sliding chandelier is sounded by escaping gas, and thus a defect is at once, clearly indicated; and safety so far secured. The usual 3 weights of the sliding chandelier, are also in this patent, got rid of; and in their place, a balance, encircling the tube is employed.

MINING.

The Discovery of Rich Coal Mines, near the port of Paeta, is recently announced in the Gaceta del Sur, of Lamheyque (Pacific). The coal is described as being of good quality, and abundant in quantity.

A Fatal Colliery Accident (from explosion of fire-damp) occurred recently in the Maudlin seam of the Washington Old Colliery, near Washington, Durham. By the explosion, which took place at 6 a.m., four of the pitmen were killed, as likewise several horses and ponies. The seam, to which there was a supply of air equal to 120,000 cubic feet, had been examined by the overseer an hour before the accident, so that the cause of the accident remains unexplained.

A new Gold Discovery, in British Columbia, has, per late advices, caused great excitement in Victoria. On the beach, immediately below Beacon-hill, and within one mile and a half of Victoria, a rich vein of gold, bearing quartz has been lighted upon, the yield of which promises an average of 200 dollars per ton; the average yield in California rarely exceeding 30 dollars per ton.

Slag from Iron Mines.—In laying a portion of the "East India Line" of railway, the engineers met with large quantities of Slag, left in old iron mines in one of the districts passed through, with which they ballasted some miles of the permanent way.

The Launcestown (Australia) Quartz Company has renewed operations, it is said, with great success. The local Government Geologist has made a short visit to this district, and has made to the Chief Secretary of the colony a very satisfactory report of the auriferous region.

Blasting Operations on an unusually large scale, by the Tredegar Iron Company, recently took place at Beaufort, an immense ledge or bench of rock, from 18 to 39ft. wide, and about 160ft. long, had to be removed. For this purpose, a hole, 4in. in diameter, was powder was poured in, and fired as before. The effect was violent. From 300 to 400 tons of rock were thrown down in huge masses to the bottom of the quarry; the whole mass of rock moved throughout from top to bottom, and no less than 10,000 tons of rock were displaced by the explosion.

The Mariquita Mining Company (New Canada) are in legal difficulties with the New Granada Government, who heve entered an action against the Company to cancel the lease of the Santa Ana mines.

Copper-Bars raised from the wreck of the *Royal Charter*. The divers who made a descent down to the wreck (31st October ult), succeeded, with assistance from on board the steam-tug, in raising abont 3 tons of eopper-bars, which had undergone some smelting, but were not in a finished state. There was a good deal of silver mixed with the copper.

Gold-Quartz Crushing in Australia.—There are now (per late aceounts), at least 30 quartz-crushing mills within a radius of 5 or 6 miles from Castlemaine, with an aggregate horse-power of about 420.

The Largest Cake of Amalgamated Gold ever produced, has been turned out at Sandy Creek [Australia]. It is the result of a portion of 60 tons of the first quartz crushed from the Corfu Reef. It weighs 1,040 ounces.

The Bullion-Room, in most of the gold-importing ships, is placed about 18ft. up from the keel, and is formed ont of a portion of the stern, to which an iron deck, iron sides, and an iron door are attached. In this room, the ingots, specie, and dust, consigned to parties in this country are deposited. In the case of the *Royal Charter*, the gold consigned to the Captain, was placed in small enbical mahogany boxes, on which were affixed the seal of the Captain, aud that of the party who committed the gold to his custody; these boxes were deposited in the Bullion-room.

Gold Mining in British Columbia: The Governor has just passed a law to regulate the working of the gold mines, and the sale of water for mining purposes, in British Columbia, and Queen Charlotte's Island. Instead of £1 a month, license fee, as formerly imposed, the miner has now, bv this new law, to pay £1 a year; this payment ensures him the other privileges conferred on the miners, more especially that of forming "Mining Boards" from among their own communities, for the regulating matters relating to Mining, "Claims," water supply, &c., subject, however, to the Governors' approval, he bcing always kept furnished with information on all mining matters, by the Gold-Commissiouers, to whom great powers of interference for the protection of the rights of the universe are given.

The Coal raised in New South Wales in 1856 was valued at £148,158; in 1849, at only £14,647.

WATER SUPPLY.

The Aqueduct from Loch Katrine to Glasgow is about 34 miles in length; ten or eleven of which consist of ridges of rock of the hardest description, forming the spurs of Ben Lomond, which rises 3000ft. above the level of the works. Through these ridges in a tolerably straight direction, the aqueduct is carried principally by tunneling for a distance of 26 miles to the great reservoir. Loch Katrine is 360ft. above the of the tide at Glasgow, an elevation which allows for the loss of fall in the conveyance of the water; and still seems a pressure of 70 or 80ft. above the highest summit of land within the city.

Water Ditches, or Mining Canals in British Columbia. An important enterprise connected with and essential to mines, is the supplying the mines with water by artificial means. This industry is specially protected hy the new mining law, on the owner of a "water-ditch" or canal, paying a Government rent of one day's receipts from the sale of the water per month. In case of dispnte as to the daily receipts to estimate this monthly rent, the master is to be decided by the Gold Commissioner, with the assistance of a jury, if he shall so think fit.

Are Wens produced by the use of impure water? Some recent experiments by M Demorlain, Chief Apothecary to the army of Italy, made in Lombardy during the late war, to ascertain whether the waters of that country could be the cause of the prevalence of Wens these, a report of which experiments has been forwarded to Marshall Vaillant, appear to throw some light on this hitherto much vexed question. From the ex mination of thirty samples of water taken at different places, the fact is elicited that in those waters taken where wens were most common, there was an absolute absence of salts of magnesia, and also of chlorine. The question now remains for the faculty to determine whether the waut of those principles be sufficient to account for the existence of the deformity alluded to.

Of the Utilization of Lakes, a remarkable instance is affordad in the Loch Katrine and Glasgow waterworks; the Highland Lakes appropriated to which, and for the supply of the mill owners, fisheries, and other interests in the river from which water will be abstracted, are—Loch Katrine. 8 or 9 miles in length, with a surface of 3,000 acres Loch Venacher, 4 miles in length, with an area of 900 acres; and Loch Drinkie, with an area of about 150 acres; having, altogether, a water-snrface of upwards of 4,000 acres, and containing, within the limits to which they may be raised or lowered, about 1,600,000,000 cubic feet of water. The drainage, area of Loch Latrine is 22,800 acres; and of Loch Venacher and Loch Drunkie, 23,000 acres; making a total of 45,000 acres. on this, the average fall of rain is between 70 and 80 inches per annum. On the eollecting ground of Loch Katrine, the fall is about 80 inches on the average of 5 years observations. The storage which is provided by the works which have been executed, is equal to 50,000,000 gallons per day, for 120 days, without rain. It is obtained by raising the water by proper masonry, and sluice-gates, at the outlet, 4 feet above the ordinary summer level; and by drawing it down if necessary, to 3 feet below that level, giving 7 feet in depth in all.

The Apparatus for Distilling Fresh Water from the Sea, the invention of the late Sir Thomas Grant, and now in general use in the navy, is either connected with the ordinary ship's galley, or (in the ease of a steam-vessel), with the boilers or the ship. The papers laid before Parliament on the subject of the Distillery Apparatns, contain a report from the Commander-in-Chief of the Baltic Fleet, stating that in 3 months, eleven ships distilled upwards of 4,700 tons of water; aud that the "Wye" was expressly fitted up with the Distillery Apparatus, and sent to the Crimea to assist in supplying fresh water to our transports and troops, this vessel, alone, was capable of producing npwards of 10,000 gallons of fresh water daily.

ACCIDENTS FROM MACHINERY, &c.

A Fatal Accident to a Boiler-Cleaner occurred recently at Langdale's Guano Works, Newcastle-on-Tyne. to a workman who was abont to clean out a boiler; whilst he was removing the first screw of the door of the boiler, the steam rushed out with such tremendons force as to fling him with great violence against a wall at a distance of about four yards. He died soon afterwards. The usual precaution of blowing off the steam for some time previously to the operation ef cleaning, would appear, in this instance, to have been neglected by the engineers.

Unguarded Machinery.—At the Carding works of Messrs. Chew and Fairbrother, in Water strett, Rochdale, 12th October ult., a boy was canght by the leg in a strap and drawn up to the drawing-shaft, around which he was carried at the rate of 40 to 50 revolutions per minute for at least two minutes. His legs were fastened hy the strap to the shaft, and at every revolution his head and arms were sent with fearful foree against the beam and floor and literally broken to pieees.

An Engine-man, employed at the mill of Messrs. Ellershaw, Oil Manufacturers, Headlingley, near Leeds was recently throwng a crank on to the fly wheel whilst in motion, when he iell between the wheel and a stone wall. He was instantaneonsly struck by the wheel, and killed on the spot.

LIST OF NEW PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 17th August, 1859.

1894. A. V. Newton, 66, Chancery-lane—Construction of carriages.

Dated 24th August, 1859.

1923. G. Riley, Elm Tree Lodge, South Lambeth, Surrey—Helical refrigerators for cooling distillers' worts.

Dated 29th August, 1859.

1968. R. Besley, Fann-street, Aldersgate-street, London.—Machinery for printing and perforating documents.

Dated 31st August, 1859.

1982. G. S. Fleming, 498, New Oxford-street—Candles for the purpose of indicating time.

Dated 13th September, 1859.

2083. A. B, Seithen, 6, Alpha-terrace, Caledonian-road—Apparatus for shaping cork stoppers.

2084. W. B. Adams, 1, Adam-street, Adelphi.—Permanent way of railways.

Dated 20th September, 1859.

2144. L. Matthews, 28, Fletcher-gate, Nottingham—Machinery to be employed in introducing wire upon fabrics, for the purpose of ornamenting the same.

Dated 21st September, 1859.

2146. G. K. Geyelin, 462, Oxford-street.—Machinery for making solid and perforated bricks, and socket pipes.

2150. G. D. Robinson, 15, Church-street, Islington.—Apparatus for regulating the pressure of gas.

Dated 26th September, 1859.

2176. R. Kay, Busby, Renfrew, N.B.—Preparing textile fabrics.

2178. G. Addenbrooke, Greenhill Wimbourn, Wolverhampton—Raising and lowering boats and other vessels from one water level to another.

Dated 28th September, 1859.

2196. J. F. Stanford, 7, Denbigh-place, Pimlico.—Apparatus for giving warmth to the lower extremities and members of invalids and others when travelling.

2198. E. T. Simpson, Walton, near Wakefield, Yorkshire—Apparatus for condensing distilled fatty matters.

Dated 29th September, 1859.

2204. T. Allan, Adelphi-terrace, Westminster.—Improvements in applying electricity for telegraphic purposes.

Dated 30th September, 1859.

2214. E. Sonneborn, 39, Finsbury-square, London.—Manufacture of cement.

Dated 1st October, 1859.

2230. J. Banghan, Pimlico.—Manufacture of soap.

Dated 3rd October, 1859.

2236. R. A. Brooman, 166, Fleet-street.—Treating clay.

Dated 5th October, 1859.

2252. F. J. Dove, Studd-street, Islington.—Iron-clasped bonding plates for joists.

2256. W. G. S. Mockford, 67, Upper Thames-street, London.—Manufacture of starch.

2250. T. Cook, Coburg-road, Old Kent-road, Surrey—Improved tools for making screws.

2258. R. Fisher, Westbourne-grove—Photographic stereoscope slides.

2260. T. H. Dodd, Besborough-place, Pimlico.—Portable apparatus for the use of smiths.

2262. W. E. Newton, 66, Chancery-lane.—Blankets used for printing calicoes.

2264. J. Pritchard, 6, Whitehall, Middlesex.—Spurs.

2266. J. Webster, Birmingham.—Springs for carriages.

2268. J. Turpie, North Shields.—Fore and aft gaff and boom sails of ships.

2270. G. Long and J. Archer, Landport, Hants.—Manufacture of manure.

Dated 6th October, 1859.

2272. J. P. Scott and E. Scott, Manchester.—Instrument for boring and drilling.

2274. E. O'Connell, Bury, Lancashire—Apparatus for supplying liquid nourishment to infants.

2276. E. O. Tindall, Scarborough.—Apparatus for crushing or reducing grain.

2278. A. M. Ferry, Edinburgh.—Manufacture of oil.

2280. A. Hind, 60, High-street, Poplar, and J. Lowenthal, 16, Little Tower-street.—Manufacture of pottery and china wares.

2282. R. Warry, Brompton Barracks, Kent.—Breech-loading ordnance.

2284. G. Gibson, and J. Gibson, Southall, Middlesex.—Machinery for raising and removing soil or earth from sewer excavations.

Dated 7th October, 1859.

2286. W. Brookes, 73, Chancery-lane.—Securing the tyres of railway carriage and engine wheels.

2288. J. Dixon, Newcastle-upon-Tyne—Apparatus for supplying water to water-closets.

Dated 8th October, 1859.

2290. W. Dawson, Blackburn, and T. Singleton, Over Darwen, Lancashire.—Apparatus applicable to looms for weaving.

2292. J. H. Johnson, 47, Lincoln's-inn-fields.—Treatment of fatty matter.

2294. P. Robertson, Sun-court, Cornhill.—Preparing, boiling and fermenting worts.

2296. H. Monument, Myrtle-street, Dalston, and G. Berry, Buttesland-street, Shoreditch.—Apparatus for raising and moving earth.

Dated 10th October, 1859.

2297. J. S. Parfitt, 60, Boulevart de Strasbourg, Paris.—A registering nautical velocimeter for measuring the speed of ships.

2298. J. Bentley, and and H. J. Sillem, Liverpool—Breech-loading fire-arms.

2299. C. A. Shaw, Biddeford, U.S.—Machinery for shaping or bending tinned sheet iron.

2300. T. Knowles and J. Knowles, Manchester, and A. Rigg, Chester.—Apparatus for shaping and drilling metals.

2301. G. White, 34, Dowgate hill, Cannon-street.—Frames for spinning and twisting yarn.

2302. G. Davies, 1, Serle-street, Lincoln's-inn—Manufacture of paper pasteboard.

2303. S. B. Parker, Deptford, Kent.—Apparatus for revivifying oxide of iron.

2304. W. Martin, jun., Dundee.—Method of damping linen.

Dated 11th October, 1859

2305. L. J. Jeannin, Pontarlier, France.—Pumps.

2306. C. F. Beyer, Gorton Foundry, near Manchester.—Machinery for horing and drilling.

2307. J. L. Tenting, senr., Paris.—Buffers for railway and other carriages.

2308. J. L. Tenting, senr., Paris.—Axles of railway carriages.

2309. J. Earle, Melbourne, Derbyshire.—Applying harness to the draft of carriages.

2310. W. D. Hart, Edinburgh.—Pressure regulating apparatus for gas burners.

2311. J. Smith, Oldham.—Breech-loading fire-arms and ordnance.

2312. P. G. Cunningham, Salishnry, Wiltshire.—Construction of artificial teeth and gnms.

2313. A. Whytock, 12, Little Saint Andrew-street, Upper Saint Martin's lane.—Coating sheets of metal with other metals.

2314. A. V. Newton, 66, Chancery-lane.—Mode of clarifying and defecating saccharine solutions and juices.

2315. F. A. Lohage, Unna, Westphalia, Prussia.— Water wheel.

Dated 12th October, 1859.

2316. J. Skertchly, Ashby-de-la-Zouch, Leicestershire.—Ma

nufacture of mosaic and other ornamental tiles and slabs.
2317. G. Scott, 3, Priory-cottages, Peckham, Surrey.—Generating elastic fluids.
2318. W. Day, Burton Latimer, near Wellingborough, Northamptonshire.—A direct-action rotary steam-engine.
2319. A. A. De Reginald Hely, 2, Park-village West, Regent's Park.—Manufacture of tobacco for smoking purposes.
2320. J. Carrick, Glasgow.—Commodes, water-closets, and other sanitary appliances.
2321. Z. Nuttall, Stockport.—Looms for weaving.
2322. J. Thomson, Notting-hill, Middlesex.—Hydraulic valve and apparatus to be used in the manufacture of gas.
2323. T. Rothwell, Manchester.—Warehouses and other buildings in which "well-holes" are constructed for the purposes of light and ventilation.
2324. E. H. Baron and J. Wheater, Lee Mill, near Bacup, and L. Tatley, Crawshaw Booth, Lancashire—Carding engines for carding cotton.
2325. J. Tangye, Birmingham—Motive power engiens.
2326. E. H. Taylor, Rnbicon Works, Saltney, Chester—Apparatus applicable to the permanent way of railways.
2327. C. H. Southall, Blackburn—Boots and shoes.
2328. C. P. Moody, Corton Denham, Somersetshire—Apparatus for raising grass and other crops on to stacks.
2329. T. B. Daft, Tottenham, Middlesex—Flexible valves.
2330. H. Bright, Sandwich-street, Burton-crescent, Middlesex—Apparatus for navigating the air.
2331. T. Wells, Nottingham—Embroidering woven or lace fabrics.
2332. A. Holden, North-end, near Stalybridge, and J. Holden, Micklehurst, Chester—Machinery used in washing and drying yarn.

Dated 13th October, 1859.

2333. J. Rhone, Leman-street, Whitechapel—An indicating meter tap.
2334. W. Prosser, 24, Dorset-place, Dorset-square, Middlesex—Apparatus employed in the production of light.
2335. J. Hunter, Kilmahumaig, N.B.—Apparatus for ploughing or cultivating land.
2336. W. Burgess, Newgate-street—Reaping and mowing machines.
2337. L. H. Rosseau, 29, Boulevard St. Martin, Paris—steam engines.
2339. C. Collins, Lower-road, Islington—Manufacture of grease for lubricating the axles of railway carriages.
2340. J. F. Conscience, 8, St. John-street-road, Clerkenwell—Improved process of making bread.
2342. J. P. Henderson, Summerford-house, Stirling, N.B.—Stopcocks or valves.
2343. G. Price, Wolverhampton, Staffordshire—Locks.
2344. J. Varley, Radcliffe, Lancashire, and J. Crowther, Bradford, Yorkshire—Steam engines and boilers.
2346. G. Goldsmith, Leicester—Gas meters.
2348. H. W. C. Wise, Tichfield, Hampshire—Apparatus for making tea.

Dated 14th October, 1859.

2349. F. Levick, Monmouth—Mode of applying india-rubber.
2350. H. Chapman, Battlebarrow, Appleby, Westmoreland—Self-acting safety railway break.
2351. F. A. Leigh, Manchester—Apparatus for the manufacture of screws, bolts, and nuts.
2352. J. Fernihough, Dukinfield, Chester—Construction of steam boilers.
2353. R. Bate, Castle Mills, Stalybridge, Lancashire—Engines for carding cotton.
2354. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for breaking stones.
2355. J. Echard, Paris—Ploughing and sowing.
2356. M. Henry, 84, Fleet-street—Apparatus for washing fibrous materials.
2357. J. H. Brown, Abbey Mill House, Romsey, Hants—Preparation of gunpowder for loading fire-arms.
2358. N. Montanari, Charles-street, Soho-square, Middlesex—Apparatus for aiding children in learning to walk.
2360. J. Elder, Glasgow—Steam and other engines.

Dated 17th October, 1859.

2361. G. Berry, 19, Buttesland-street, Middlesex—Construction of glass and earthenware vessels for containing fluids.
2362. W. K. Hall, 36, Cannon-street, London—Apparatus for manufacturing cotton wadding.
2363. L. Vidie, Paris—Transmitting the motion of steam engines.
2364. S. Newberry and H. Moore, Burnley, Lancashire—Looms for weaving.
2365. G. W. Reynolds and E. Dance, Birmingham—Manufacture of baskets.
2366. W. E. Newton, 66, Chancery-lane—Rotary steam engines.
2367. W. E. Newton, 66, Chancery-lane—Preserving and disinfecting organic substances.
2368. W. Norton, Hollybank, Cavan—Kilns for drying grain.
2369. J. Bernard, Albany, Piccadilly—Boots and shoes.
2370. J. Thom and A. Kennedy, Glasgow—Looms for weaving.
2371. D. Jones, Bassaleg, Monmouthshire—Self-acting breaks to be used on railways.
2372. R. A. Brooman, 166, Fleet-street—Electro-magnetic engines.
2373. W. Hall and A. Wells, Erith, Kent—Manufacture of ropes and cords.
2374. W. Tillie, Londonderry—Sewing machines.

Dated 18th October, 1859.

2375. G. Ganouil, 93, Curtain-road, Shoreditch—Cartridge paper.
2377. J. Reynolds, 21, Bull and Mouth-street, London—Manufacture of wrought nails.
2378. A. W. Williamson, University College—Obtaining extracts from poppies.
2379. G. T. Bousfield, Loughborough-park, Brixton—Machinery for steering vessels.
2380. J. Higgins and T. S. Whitworth, Salford—Apparatus for preparing and spinning cotton.
2381. C. Hill, Cheddar, Somersetshire—Fastening for stays.
2382. W. E. Newton, 66, Chancery-lane—Machinery for spinning silk or other fibrous substances.
2383. W. E. Newton, 66, Chancery-lane—Combs or gills employed in the preparation of fibrous substances.
2384. H. Hirsch, Berlin, Prussia—A new propeller for ships.
2385. A. S. Rott, Thann, France—Substances for fixing colours in dyeing and printing.

Dated 19th October, 1859.

2386. J. H. Banks, Radnor-street, Manchester—Machinery for boring, cutting, and carving wood.

Dated 19th October, 1859.

2387. G. Worssam, 3, Oakley-crescent, City-road—Non-condensing steam-engines.
2389. J. Gordon, 3, Railway-place, Fenchurch-street, London—Apparatus for pulping coffee.
2391. T. Spencer, 192, Euston-road, Euston-square, Middlesex—Manufacture of carbonate of soda.
2392. C. Seton, Edinburgh—Wheels of carriages.
2393. C. Cowper, 20, Southampton-buildings, Chancery-lane—Photographing on uneven surfaces.
2394. G. Hart, 6, Chapel-street West, Mayfair, Middlesex—Manufacture of hats.
2395. J. J. Bowen, 136, Great Dover-street, Southwark—Manufacturing the pots for containing liquids used by publicans and others.
2396. J. Bruckshaw, Longslow, H. Bruckshaw, Hinstock, and W. S. Underhill, Newport, Salop—Machinery for elevating grain or other similar substances.
2397. W. Warne, J. A. Jacques, and J. A. Fanshawe, Tottenham, Middlesex—Manufacture of elastic hoops or bands, and other analogious elastic articles.
2398. R. Hobson, Leeds—Producing ornamental devices in glass.
2399. J. R. Palmer, Newport-cottage, Old-Ford, Bow—Manufacture of printing-ink and paints and varnishes.

Dated 20th October, 1859.

2400. E. T. Hnghes, 123, Chancery-lane—Apparatus for compressing and making caps for cartridges.
2401. R. A. Brooman, 166, Fleet-street—Apparatus for carrying on secret correspondence.
2402. P. A. Godefroy, King's Mead-cottages, New North-road, Islington—Construction of submarine cables.
2403. F. Nivelle, Paris—Sewing machines.
2404. J. Hodgson, Liverpool—Building ships and vessels.
2405. C. Hanson, Tottenham Court-road, Middlesex—Fire-arms and ordnance.

Dated 21st October, 1859.

2436. J. Musgrave, Globe Iron Works, Bolton-le-Moors, Lancashire—Steam boilers.
2407. J. H. Green, Christiansberg, U.S.—A composition for coating metals.
2408. J. T. Pitman, 67, Gracechurch-street—Mode of converting cast iron into soft malleable iron.
2410. G. T. Bousfield, Loughborough-park, Brixton, Surrey—Apparatus for steering vessels.
2411. T. S. Pridcaux, Willow-house, Hampstead—Construction of ships and rafts.
2412. W. Maltby, De Crespigny-park, Camberwell, Surrey—refining oil.

Dated 22nd October, 1859.

2414. P. Jones, Manchester—Apparatus for suspending, carrying, and laying down paper and woven fabrics, after the process of drying.
2415. G. B. Mill, Toronto, Canada West—Pressure regulating apparatus for gas burners.
2416. W. Fox, Amiens, France, and J. Willis, Little Britain, London—Manufacture of umbrellas and parasols.
2417. R. A. Brooman, 166, Fleet-street—Preparing inoxodizing oils and fats.
2418. W. Brookes, 73, Chancery-lane—Apparatus for preparing wool.
2419. S. Beardmore, 27, Albion-street, Hyde-Park—Electric telegraphs.
2420. W. Thorold, Norwich—Apparatus applied to locomotive engines for condensing steam.
2421. J. Dahlke, Providence-row, Finsbury—Preparation of charcoal.
2422. F. Wrightson, Birmingham—Purifying coal gas.
2423. F. N. Clerk, and C. Thomas, Birmingham—Cleavers or choppers.

Dated 24th October, 1859.

2424. A. L. Dowie, Glasgow—Gas burners.
2425. G. Holden, Preston, Lancashire—Machinery for spinning cotton.
2427. A. C. Bertrand, Paris—Manufacture of herbal cigarettes.
2428. R. A. Brooman, 166, Fect-street—Daylight and other reflectors.
2429. M. Fitzpatrick, 29, Boulevard St. Martin, Paris—Prevention of accidents on railways.
2430. R. Seager, Peter-street, Ipswich—Compounds of india-rubber and gutta percha.
2431. W. E. Newton, 66, Chancery-lane—Construction of ships or vessels.
2432. W. E. Newton, 66, Chancery-lane—Paddle-wheels.

Dated 25th October, 1859.

2433. H. S. Rosser, 17, Upper Philimore-gardens, Kensington—Electric telegraph cables.
2436. W. C. Day, Strand—Stockings and drawers.
2437. W. A. Matthews, Sheffield—Springs.
2438. J. M. Napier, York-road, Lambeth—Printing machines.
2439. E. Ellis, St. Ann's Wells-road, Nottingham—Manufacture of lace.
2440. H. C. Hurry, Worcester—Applying magnetism as a motive power.
2441. E. S. Tebbutt, Leicester—An improved manufacture of elastic fabrics.
2442. A. McGlasham, Coal-yard, Drury-lane, Middlesex—Refrigerators for cooling worts.

Dated 26th October, 1859.

2443. W. Clark, 53, Chancery-lane—Preparation and application of baths or bathing media.
2444. J. J. Bourcart, Manchester—Mules for spinning.
2445. J. Z. Kay, Dundee, N.B.—Gas meters.
2446. W. W. Kennedy, Glasgow—Shirts.
2447. J. H. Paterson, Glasgow—Shirting cloths and shirts.
2448. J. W. Hackworth, Priestgate Engine Works, Darlington—Dynamic valve gear.
2450. J. Aemour, Perceton Fire Clay Works, Kilmarnock, N.B.—Apparatus for regulating supplies of solid and fluid substances.
2451. C. E. Wilson and H. G. Hacker, Monkwell-street, London—Machinery for the manufacture of chenille.
2452. R. Christy, jun., Weston, Hertfordshire—Apparatus for closing of doors.
2453. T. Whitby, Millbank-street, and W. Dempsey, Great George-street, Westminster—Ordnance and fire-arms.
2454. I. Zacheroni, Liverpool—Electric telegraphic cables.

Dated 27th October, 1859

2455. C. Stevens, 1B, Welbeck-street, Cavendish-square—A machine for scouring and polishing floors and decks of ships.
2456. P. D. Mickles, Syracuse, U.S.—An automatic railroad switch.
2457. E. H. Rascol, 4, Brydges-street, Covent-garden—Cleansing plates, dishes, and other table or kitchen utensils.
2459. R. M. Ordish, 18, Great George-street, Westminster—Railway fastenings.
2460. H. Phillips, Penhoe, and J. Bannehr, Exeter, Devonshire—Manufacture of manure.
2461. R. A. Brooman, 166, Fleet-street—Preparation of re-colouring matters or dyes.
2462. R. A. Brooman, 166, Fleet-street—Improved thread for weaving.
2463. H. Cowan, Boileau-lodge, Barnes, Surrey—Waistcoats.

Dated 28th October, 1859.

2464. A. B. Mitchell, Birmingham—Penholder.
2465. J. Plantier, Paris—Brushes and brooms.
2467. D. Dillies, Ronbaix France—Innovations in weaving looms.
2469. J. F. Cole, Devonshire-street, Middlesex—Timekeepers.
2470. J. J. Baronowski, Paris—Railway signal apparatus.

Dated 29th October, 1859.

2471. G. Ghesquière, 11, Quai Conti, Paris—A process to render gold and silver malleable and ductile.
2473. S. C. Lister, Manningham, and J. Warburton, Addingham—Dyeing silk, cotton, and china grass.
2474. C. Stannet, New-street, Covent-garden—Boots and shoes.
2475. J. S. Margetson, Cheapside—Collars.

Dated 31st October, 1859.

2477. J. A. Turner, Manchester—Rendering paper waterproof.
2479. T. C. Newby, Welbeck-street, and J. A. Raine, Wells-street, Gray's-inn-road, Middlesex—Portable bedsteads and spring mattresses.
2480. J. Ingham, Halifax, York, and G. Collier—Manufacture of fabric of the character of that technically called "camlet."
2481. J. Bolton, Halifax—Apparatus for winding thread or yarn on to shuttle bobbins.
2483. R. A. Brooman, 166, Fleet-street—Plastic compositions for building and decorative purposes.
2484. R. Chicbowski, Linow, Poland—Ploughs.
2485. J. Holmes, Pleyestowe Capel, Surrey—An improved halter-block for stable purposes.
2487. L. Pohl, Offenbach, Germany—Fastenings for bags.

Dated 1st November, 1859.

2488. C. Read, Birmingham, and I. A. Read, Smethwick, near Birmingham—A new and improved tap or stop cock.
2489. W. Spence, 50, Chancery-lane—An instrument for taking and registering deep sea soundings.
2490. A. V. Newton, 66, Chancery-lane—Apparatus for condensing and cooling vapour and fluids.
2491. J. Jones, jun., Liverpool—Ship-building.
2492. W. H. Perkin, King David Fort, St. George's-in-the-East—Manufacture of colouring matters.
2493. R. De Bary, Finsbury-square, Middlesex—Machinery for the manufacture of cigars. (A com.)

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2413. J. Avery, Essex-street, Middlesex—Rail-road weighlocks and other platform scales (A com.)—22nd October, 1859.